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**COMPLETED  
ORIGINAL**

**Space Shuttle Afterbody  
Aerodynamics/Plume  
Simulation Data Summary**

**Kenneth L. Blackwell and Leroy M. Hair**

**DECEMBER 1978**

**NASA**

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NASA Technical Paper 1384

Space Shuttle Afterbody  
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National Aeronautics  
and Space Administration

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## NOMENCLATURE

<u>Symbol</u>	<u>Definition</u>
a	Speed of sound
A	Area
b	Constant in nozzle pressure correction; see equation (2)
CTPB	Carboxy-terminated polybutadiene
d, D	Diameter
L	Length
m	Gradient in nozzle pressure correction; see equation (2)
M	Mach number
MOC	Method of characteristics
n	Exponent on $\gamma$ in simulation parameter
P	Pressure
PBAN	Polybutadiene acrylonitrile
psi	Pounds per square inch
q	Dynamic pressure
r, R	Radius
$R_c$	Radius of curvature of nozzle throat profile
T	Temperature
V	Specific volume

## NOMENCLATURE (Continued)

<u>Symbol</u>	<u>Definition</u>
$X$	Axial distance
$\gamma$	Specific heat ratio
$\delta_j$	Initial slope of exhaust plume
$\epsilon$	Nozzle expansion ratio, $A_{ex}/A_*$
$\theta_n$	Nozzle wall angle
$\nu$	Prandtl-Meyer angle
$\phi$	Angular position of pressure tap
<u>Subscripts</u>	
amb	Ambient
b	Base
c	Chamber
ex	Nozzle exit
j	Plume boundary immediately after nozzle exit
t	Total
w	Wall
$\infty$	Freestream
*	Throat

## NOMENCLATURE (Concluded)

### Configuration Buildups (see Table 5)

$B_1A_1$	Body, cone-ogive-cylinder, small; with short afterbody
$B_1A_2$	Body, cone-ogive-cylinder, small; with long afterbody
$B_1A_3S_1$	Body, cone-ogive-cylinder, small; with ET-class afterbody and small SRB's
$B_2A_4S_2$	Body, cone-ogive-cylinder, large; with ET-class afterbody and large SRB's
$S_3F_1$	SRB-alone with 10 deg flare
$S_3F_2$	SRB-alone with 20 deg flare

### Other Configuration Elements

$G_1$	Gas — air
$G_2$	Gas — $CF_4$
$G_3$	Gas — from 2 percent aluminum/CTPB/ammonium perchlorate solid propellant
$G_4$	Gas — from 16 percent aluminum/PBAN/ammonium perchlorate solid propellant No. 1
$G_5$	Gas — from 16 percent aluminum/PBAN/ammonium perchlorate solid propellant No. 2
$N_{i, i=1-34}$	Nozzle — see Figure 8 and Table 3

# SPACE SHUTTLE AFTERBODY AERODYNAMICS/ PLUME SIMULATION DATA SUMMARY

## SUMMARY

A series of parametric wind tunnel tests was conducted to provide a data base for developing a simulation of afterbody/base aerodynamics for multibody/multibase rocket-powered vehicles (such as the Space Shuttle) which use unheated air as the simulant gas in development wind tunnel tests. The tests described herein were parameterized on external configuration, nozzle internal configuration, base geometry, propulsion gas type (air,  $\text{CF}_4$ , solid propellant exhausts), and freestream Mach number (0.5 to 3.5). The tests were conducted over a 4 year period in the MSFC 14-Inch Trisonic, AEDC-PWT-4T, and Ames 11-Foot wind tunnels. This report presents the data and pertinent reference information which would be necessary to perform an analysis which would lead to a simulation procedure.

The type of data obtained during the tests described herein include model base, afterbody, and nozzle internal surface static pressure distributions, model chamber pressure and temperature, and freestream conditions.

Also included is a brief description of simulation procedures that have been used by the Space Shuttle program.

## I. INTRODUCTION

Design of rocket-powered vehicles such as Saturn I and V, Space Shuttle, and large military rockets is considerably influenced by the aerodynamic effect induced by the main propulsion rocket engines. Besides stability, control, and performance, there are structural considerations such as base heat shield loads, engine hinge torques, and interelement attach loads in multibody configurations. Aerodynamic design data for these vehicle types are usually obtained from wind

tunnel tests of scaled vehicle models where the main propulsion engine plumes are simulated by flowing gases such as air or some product of combustion through model nozzles.

The present study, which began in 1973, concerns the development of a plume simulation procedure for use in design of the Space Shuttle Launch Vehicle (SSLV). The approach taken is based on knowledge gained during the Saturn programs. At the completion of the Saturn V program, a study [1] was conducted to evaluate techniques used to obtain design base pressure values. Comparison of design values with those from flight telemetry were in variance by as much as 50 to 100 percent in the transonic Mach number range. These inaccuracies were attributed to several factors that had existed in the Saturn V wind tunnel simulations (e.g., a lack of knowledge of the prototype and model engine plume characteristics, insufficient parametric variation for model tests, simulation techniques, and test conditions).

Because the SSLV is a more complex configuration than previous vehicles with its multi-base/engine arrangement (Fig. 1), it was estimated that the vehicle performance and structural integrity would be more sensitive to plume effects. Furthermore, the accuracies achieved during the Saturn V program were considered inadequate for Space Shuttle plume simulation. The literature was also probed for comparison of flight base pressure with that predicted by wind tunnel

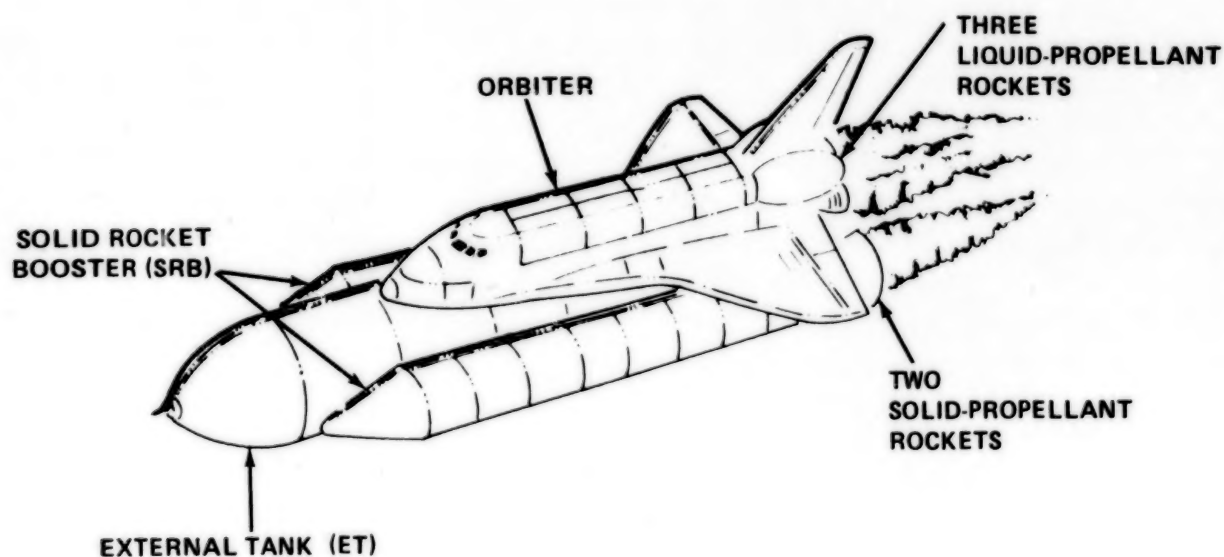


Figure 1. Shuttle launch configuration.



simulations on large military launch vehicles. Again, similar base pressure prediction accuracies were found. It was then determined that a program should be initiated to develop improved plume simulation technology.

The basic plan called for conducting a series of parametric wind tunnel tests that had sufficient controls to allow independent assessment of the pertinent variables. Variables included nozzle geometry, propellant gas type, chamber pressure, and chamber temperature for fixed model external geometry and wind tunnel freestream conditions. The previously mentioned matrix of variables was then repeated for configuration types which are important to the SSLV such as multiple nozzles and multiple bases. The propellant gases were chosen to encompass both air and SSLV prototype gasdynamic characteristics. Then, correlations could be tried until one was found which would reasonably overlay the base pressure effects using either air or prototype propellant gases. This approach could also be attempted for the various external configuration types and freestream Mach numbers to determine their applicability over the range of conditions that would be encountered with the SSLV. The objective of this report is to present the results of these tests in a compact synthesized form that will allow easy access to pertinent information for present and future analysis.

## II. TECHNICAL APPROACH

### A. Ground Rule

Unheated air was chosen as the simulant gas to be used for conducting SSLV wind tunnel tests where the main propulsion plumes were to be simulated for steady-state aerodynamic purposes other than heating. The reasons for this decision were economics of data acquisition and previous experience with prototype simulations. For the number of data points required to describe the SSLV aerodynamics, combustion process simulations would be too slow and expensive. Furthermore, experience with the Saturn V program indicated that combustion process simulations were no better than cold flow simulations in describing the plume induced aerodynamic effects.

### B. Saturn V Experience

There were several facts learned from the Saturn V program which influenced the approach taken for the Shuttle plume simulations. First, it was difficult to model the plume or to calculate the plume flowfield properties of the

prototype engines (F-1) of the Saturn V due to engine design peculiarities. The F-1 had an oxygen-to-fuel ratio gradient throughout the engine nozzle and plume. Furthermore, exhaust products from the engine turbines (that drive the main pumps) were dumped into the engine nozzle bell. The emphasis here is the fact that if the prototype flowfield characteristics are unknown, it will be impossible to provide an adequate simulation. Therefore, in conducting a program to provide a simulation for Shuttle, the ability to model and calculate engine plume characteristics must be considered. Second, only design point test conditions were obtained on the Saturn program, which limited the analysis that could be conducted as well as limiting the data application to a nominal trajectory. Finally, performances of the Saturn wind tunnel model nozzles were not adequately established, which further limited post-test/flight analysis. Therefore, it was believed that for a plume simulation program to be a success it would be necessary to fully understand the model and prototype nozzle and plume flowfields, and to conduct the wind tunnel tests with some parametric variations.

### C. Fundamental Phenomena

The basic phenomena of main propulsion plume induced aerodynamics are understood in terms of overall flowfield characteristics. However, due to its complexity the ability to compute the interacting flow between the engine plume and the external flow has eluded investigators (except for some simple geometries such as a cylindrical or boattailed afterbody with a single main propulsion nozzle). Similarly, the problem has caused difficulty for the experimenters who would like to develop wind tunnel simulation procedures by which design data could be obtained for rocket-propelled vehicles with plume induced aerodynamic effects. The following discussion of the basic plume interaction phenomena provides a basis for this study.

Base pressure is a prime indicator of the overall effect of a propulsion plume on the aerodynamics of the remainder of the vehicle. Figure 2 illustrates the general trend of base pressure as a function of engine chamber pressure. As chamber pressure increases from zero, base pressure decreases from the power-off value to a lesser value due to viscous aspiration by the plume. Then, as the plume size increases, there is an increasing compression effect until the point where there is separated flow on the afterbody of the vehicle. Various vehicles will operate over all or parts of this range of conditions. In Figure 2 the insets ①, ②, and ③ characterize the flowfields for aspiration,



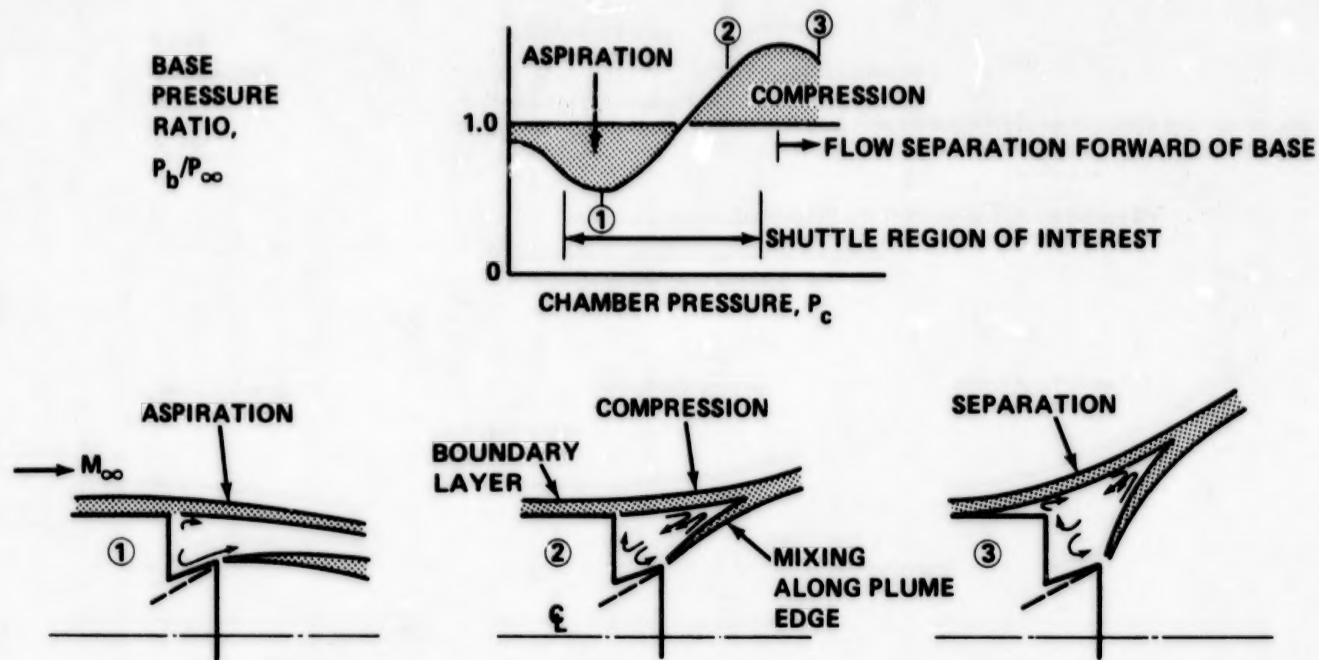


Figure 2. Plume induced aerodynamic trends.

compression without separation, and compression with afterbody flow separation, respectively. From an SSLV load sensitivity viewpoint, the main region of interest is from the aspiration region to high in the region of compression without separation. Although the SSLV eventually reaches altitudes where afterbody flow is separated, by then the loads have subsided. Therefore, the present plume simulation efforts were primarily concerned with the area between the aspiration region to the compression region short of flow separation.

For this plume induced aerodynamic phenomenon, base pressure is hypothesized to be the fundamental quantity of interest. Then, to investigate this simulation problem in a parametric fashion, it is desired to know the measurable parameters considered for this investigation: model external geometry, external flow conditions ( $M_\infty$ ,  $P_{t_\infty}$ ,  $T_t$  - air assumed), nozzle internal geometry, and internal flow conditions ( $P_c$ ,  $T_c$ ,  $\gamma$ ,  $R$ , etc. - thermochemical characteristics which are fixed for each exhaust gas).

## D. Simulation Status

At the time this effort began, a study had been completed by Lott, et al. [1] of Saturn V flight base pressure results compared with those predicted through wind tunnel simulation, including a survey of the literature to expose and compare all known methods for simulation of rocket exhaust plumes and their effect on base pressure. The prime simulation used for the Saturn V cold flow tests was that of Goethert and Barnes [2]. The Goethert and Barnes procedure calls for a geometrically similar wind tunnel model test at trajectory Mach number in air with the rocket exhaust simulated by matching the  $P_\infty / P_{ex}$  and  $d\nu/dp$ . (For small plume expansion angles, matching  $d\nu/dp$  causes plume shape to be matched; however, for large expansions considerable error can occur.) However, Saturn flight results did not compare favorably with wind tunnel data employing the Goethert and Barnes simulation [1]. Besides shortcomings in the simulation parameters, the lack of correlation was attributed to several factors: lack of sufficient nozzle calibration, lack of knowledge of complex prototype plume, and Reynolds number deficiencies. Furthermore, neither this simulation parameter nor any others proposed in the literature had been subjected to a systematic parametric investigation to ascertain their validity with a controlled prototype compared to a simulant. This study was initiated to provide a data base from which a simulation could be determined.

## E. Technical Approach Details

After considering the problem of obtaining an improved plume simulation for use in Space Shuttle wind tunnel testing, it was decided that a building block parametric approach would be best. The approach would be empirical where a set of experimental (wind tunnel) data would be gathered to form the basis for developing simulation parameters. Then, variations of simulation parameters found in the literature would be compared to this data base to attempt a correlation of a "prototype" and a simulant gas for constant external conditions. Using basic physical concepts and aerodynamic theories, the correlation (i.e., simulation) parameters would be further molded to a form which could be used in a practical wind tunnel test situation. From this concept a set of generic tests was formulated to provide the parametric data required. Parameters to be considered included configuration, nozzle geometry, prototype and simulant gases, gas temperature and pressure, and freestream Mach and Reynolds numbers. It was decided to use a simple classic configuration (e.g., the cone-ogive-cylinder) as a baseline for investigation of the plume-to-freestream interaction in the base region (Fig. 3). Initially, the base geometry was limited to two configurations: (1) a classic single nozzle with the exit plane aft of the base and (2) a triple nozzle arranged symmetrically on the base with the exit planes also aft of the base (Orbiter class). Using these configurations as baselines, the remaining parameters were varied. As illustrated in Figure 4, two gases were chosen as prototypes: (1)  $\text{CF}_4$  for its variable  $\gamma$  characteristics at medium temperatures and (2) an aluminized solid propellant for its two-phase and high temperature characteristics. Air was used as the primary simulant gas. Later, helium was used to obtain a different constant  $\gamma$  flow. Table 1 lists the matrix of gases and configurations that was used during this test series. When testing of these baseline configurations was completed, data were obtained for a configuration whose aft portion was modeled after the Shuttle External Tank (ET)/Solid Rocket Booster (SRB) combination to obtain configuration variations for the flared base SRB and the nearby unpowered ET base. Figure 5 shows the overall test program matrix. The tests have been assigned a test series number from 1 to 10. The NASA series numbers are cross-referenced in Figure 5. The figure also shows the type gas, configuration, and test facility used during each test series. It should be noted that data from three tests were not included because of their questionable quality; elements of those tests vital to the program goals were incorporated into other tests.

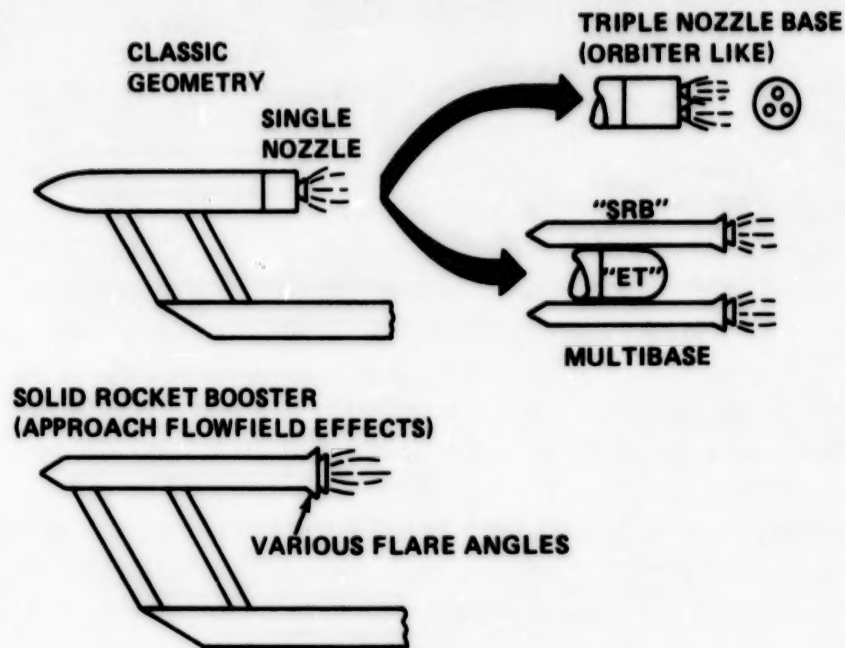


Figure 3. Experimental concept.

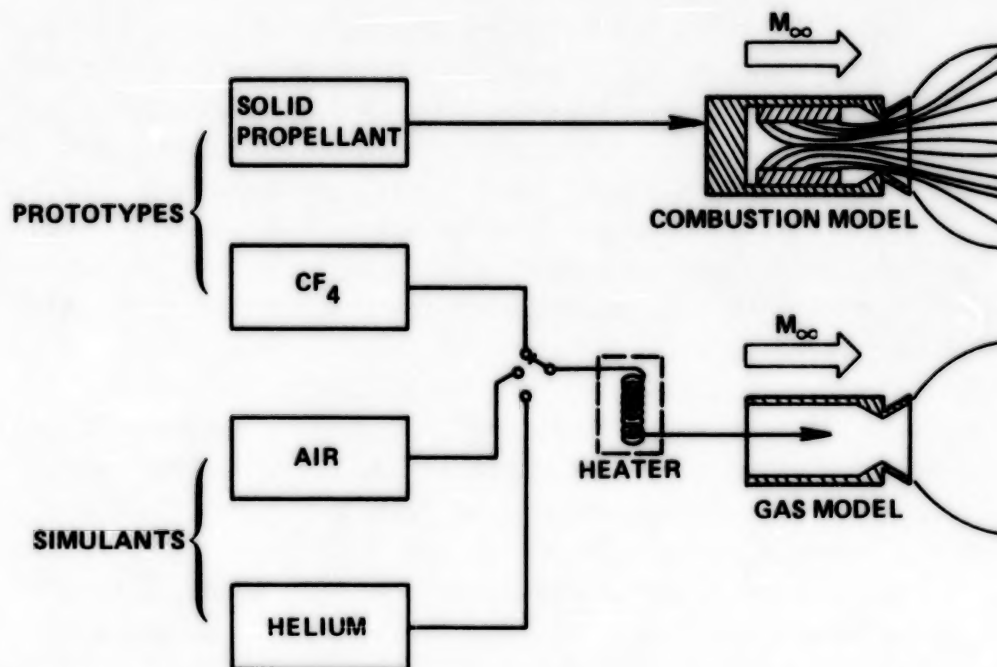


Figure 4. Schematic of gases used.

TABLE 1. GENERAL TEST MATRIX

Gas	Model Configuration			
	Classic Geometry (Single Nozzle)	Orbiter Class (Triple Nozzle)	ET/SRB Class (Triple Body)	SRB Class (Flare)
Helium	✓	✓		
Air	✓	✓	✓	✓
CF <sub>4</sub>	✓	✓	✓	✓
2% Aluminum <sup>a</sup>	✓			
16% Aluminum <sup>b</sup>	✓		✓	

- a. Combustion products of ammonium-perchlorate-based solid propellant with 2 percent aluminum in CTPB binder.
- b. Combustion products of ammonium-perchlorate-based solid propellant with 16 percent aluminum in PBAN binder.

Fundamental to this program was an understanding of the model nozzle performance at least to the exit plane. Based on experience with the Saturn V base pressure program and observation of other programs, it was believed that errors between flight and wind tunnel may have been the result of a lack of knowledge concerning the flow in the prototype and model nozzles. To conduct a parametric program such as this, it would be imperative to be able to accurately quantify parameters that would possibly be used in a simulation equation [e.g., temperature and pressure (and thus  $\gamma$  or other thermodynamic properties)]. Therefore, great care was taken to provide instrumentation from which the nozzle performance could be determined. Furthermore, each nozzle was calibrated under quiescent external flow conditions.

Finally, with known external flow properties at the base (essentially freestream for this slender cylinder) and known nozzle exit conditions, a position is established from which an empirical analysis of a set of parametric wind tunnel data can be conducted. This analysis would establish whether a simulation parameter exists for general use within the range of conditions encompassed by the test parameter variations and, if so, would define it.



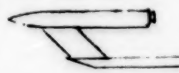



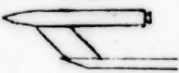


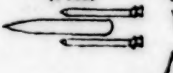
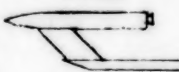
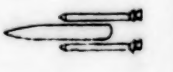
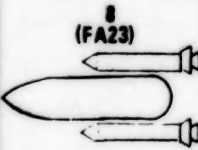
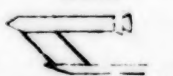


CLASSIC GEOMETRY (SINGLE NOZZLE)		ORBITER CLASS (TRIPLE NOZZLE)		ET/SRB CLASS (TRIPLE BODY)	SRB CLASS
SOLID PROPELLANTS	AIR, CF <sub>4</sub>	AIR, CF <sub>4</sub>	AIR, CF <sub>4</sub>	AIR, CF <sub>4</sub>	
TEST SERIES 2 (MA11F)  BASIC	1-A (MA10F)  BASIC	1-B (MA10F)  BASIC			MARSHALL 14 x 14 INCH TWT
		3 (FA11)  LOW $\delta_j$	DATA QUESTIONABLE, NOT PRESENTED		
5 (FA7)  TRANSONIC	4-A (FA6)  TRANSONIC	4-B (FA6)  TRANSONIC	4-C (FA6)  BASIC		AMES 6 x 6 FOOT SWT
6 (FA22)  CORRECTION			7 (FA20)  CORRECTION		AEDC 4T
			8 (FA23)  SOLID PROPELLANTS		AMES 11 x 11 FOOT
	DATA QUESTIONABLE, NOT PRESENTED			10 (FA19)  LOCAL MACH NO. (FLARE)	MARSHALL 14 x 14 INCH TWT
	9-A (FA15)  FILL IN GAPS (ALSO, He)	9-B (FA15)  FILL IN GAPS (ALSO, He)			

Figure 5. Overall program schematic.

### III. APPARATUS

Four types of equipment were used in this test program: wind tunnels, models, auxiliary equipment, and instrumentation. Each is described in the following paragraphs.

#### A. Test Facilities

There were three wind tunnels used in this program. The first facility was the NASA/MSFC  $14 \times 14$  Inch TWT [3], an intermittent blowdown, variable-density type with a  $35.6 \times 35.6$  cm ( $14 \times 14$  in.) square test section. The nozzles are symmetric about a horizontal plane. Speeds are varied in the subsonic range by a controllable diffuser, in the transonic range by regulating plenum suction around the perforations on all four tunnel walls, in the low supersonic range by interchangeable nozzle blocks, and in the higher supersonic range by tilting fixed-countour blocks. The Mach number range of the TWT is from 0.3 to 5.0. Reynolds number is proportional to Mach number for this and all of the other facilities used (Fig. 6).

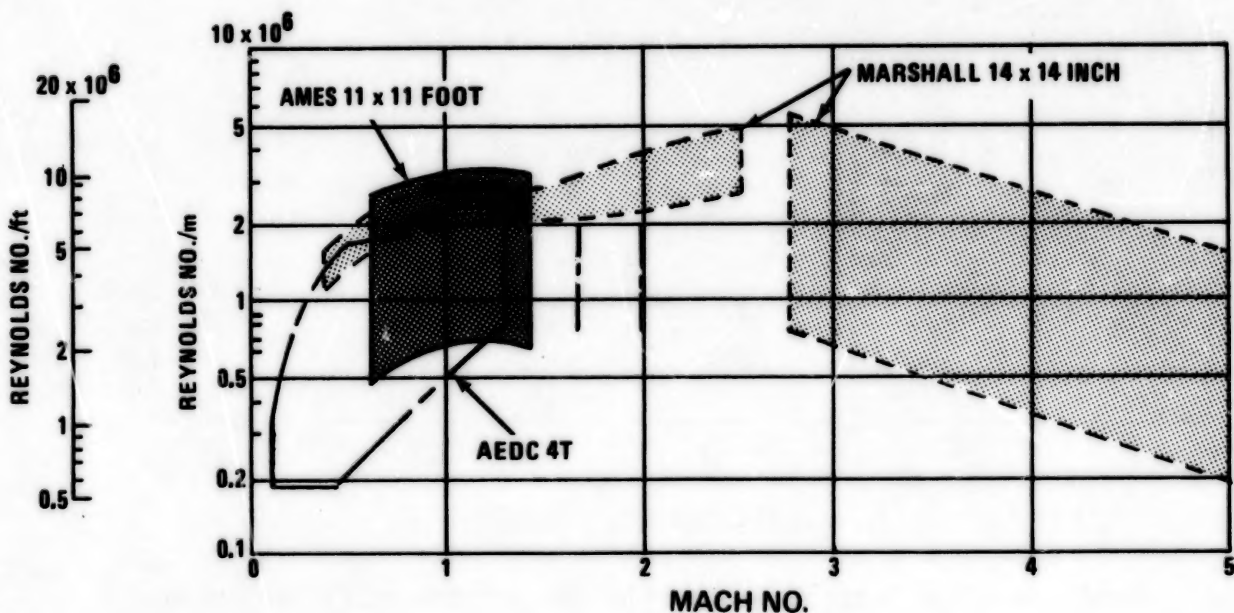


Figure 6. Wind tunnel density variability.



The second facility used was the NASA/Ames 11-Foot leg of the Unitary Plan Wind Tunnel [4]. It is of the closed-return, continuous flow, variable-density type with a  $335 \times 335$  cm ( $11 \times 11$  ft) square test section. The nozzle has adjustable sidewalls. All four walls are slotted for transonic operation. The Mach number range is continuously variable from 0.5 to 1.4.

The third facility used was the USAF/AEDC 4T [5], a closed-return, continuous flow, variable-density type with a  $122 \times 122$  cm ( $4 \times 4$  ft) square test section and four perforated walls. The nozzle contour is fixed and speed is controlled by the pressure ratio across the nozzle and by regulating plenum suction around the perforated test section.

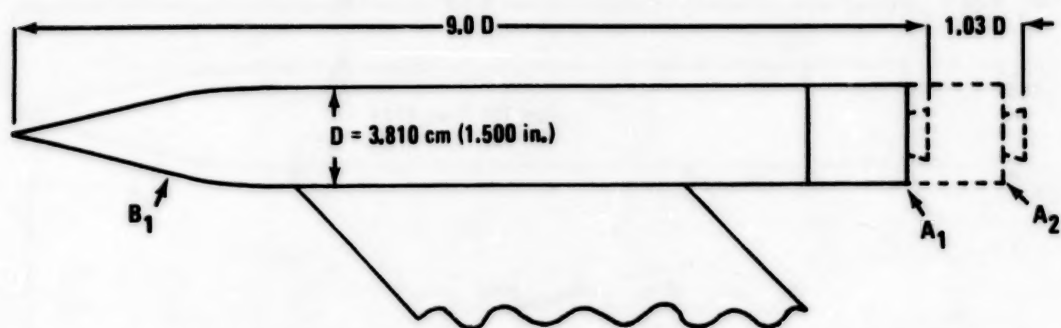
Table 2 summarizes the characteristics of these three facilities.

TABLE 2. WIND TUNNEL CHARACTERISTICS

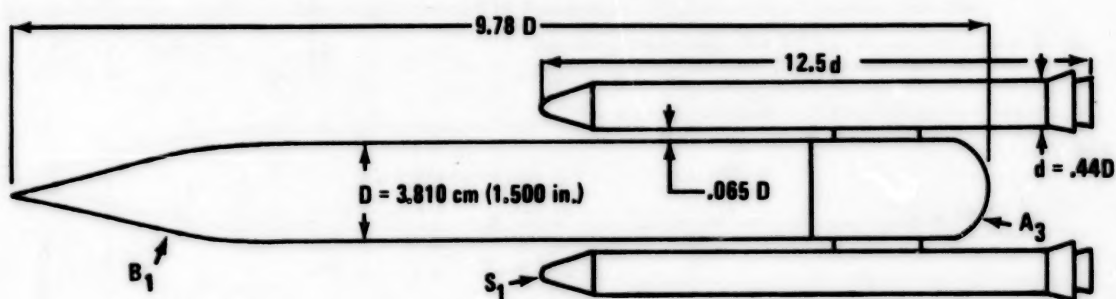
Feature	Designation		
	NASA/MSFC 14 × 14 Inch Trisonic Wind Tunnel	NASA/Ames 11 × 11 Foot Transonic Wind Tunnel	USAF/AEDC Propulsion Wind Tunnel 4T
Test Section:			
Width, cm (in.)	36 (14)	335 (132)	122 (48)
Height, cm (in.)	36 (14)	335 (132)	122 (48)
Length, cm (in.)	51 (20)	670 (264)	381 (150)
Operational Mode	Blowdown	Continuous	Continuous
Mach Number Range	0.3 to 5.0	0.5 to 1.4	0.1 to 2.0

## B. Description of Models

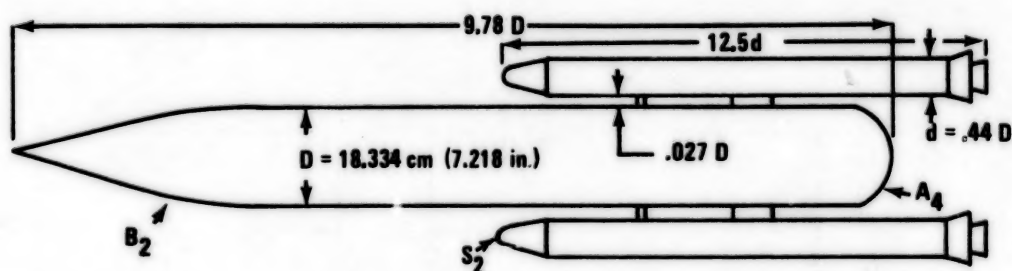
There were four basic models used in this program. Figure 7 shows the model geometries and Figure 8 the associated nozzles. All details of the model external geometries are shown in Figure 9, and all internal nozzle dimensions are given in Tables 3 and 4. Instrumentation is discussed in Section III.D.



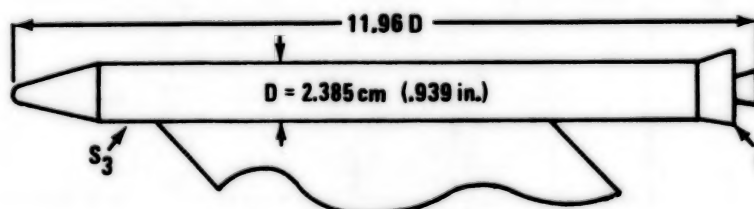
(a) CLASSIC AND ORBITER CLASS FOR GASES AND SOLID PROPELLANTS



(b) ET/SRB CLASS FOR GASES



(c) ET/SRB CLASS FOR SOLID PROPELLANTS



(d) SRB CLASS FOR GASES

Figure 7. Model summary.

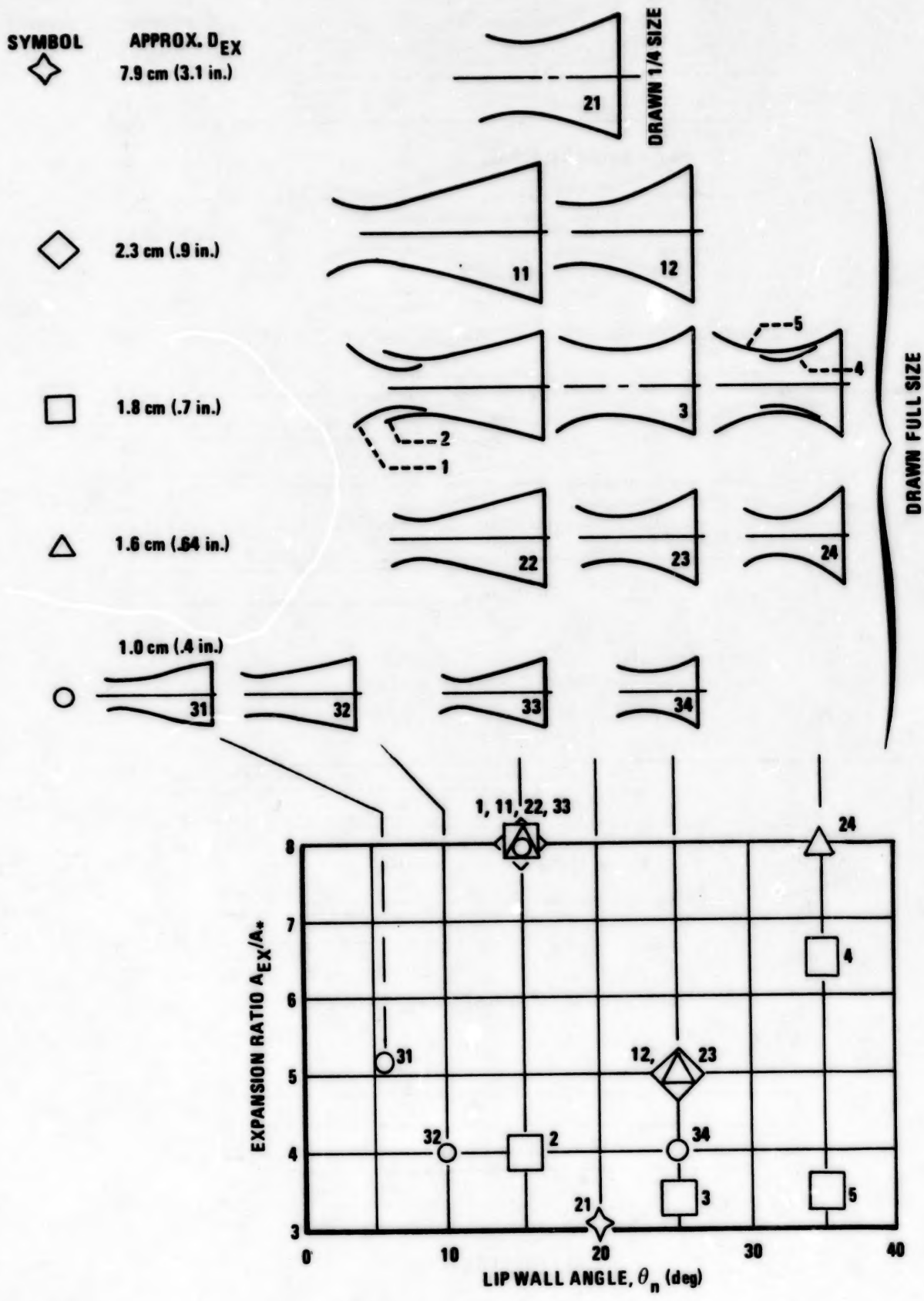
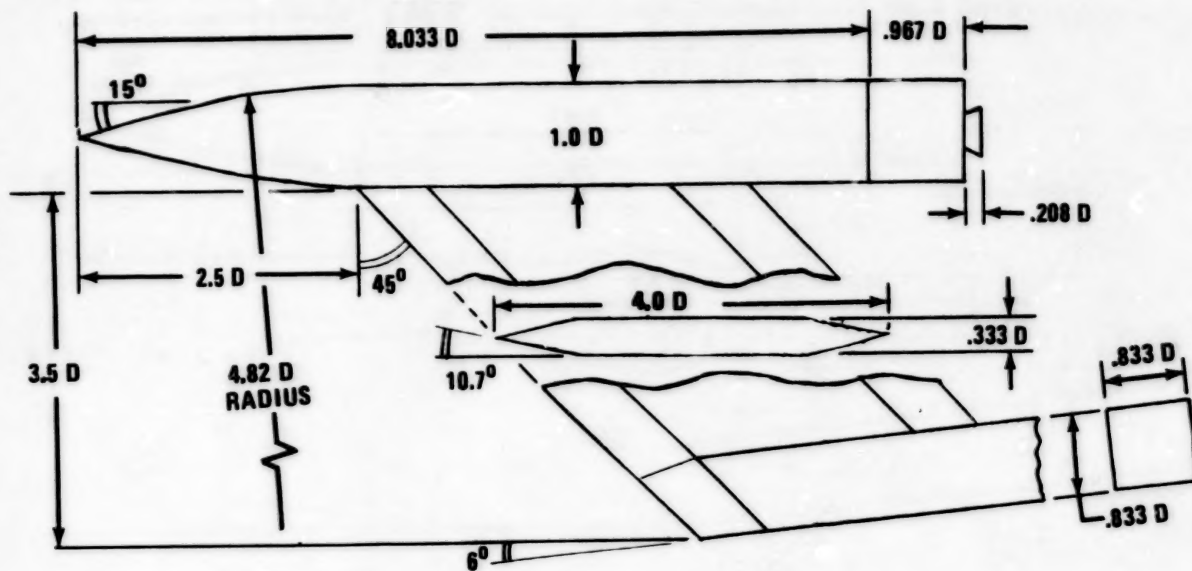
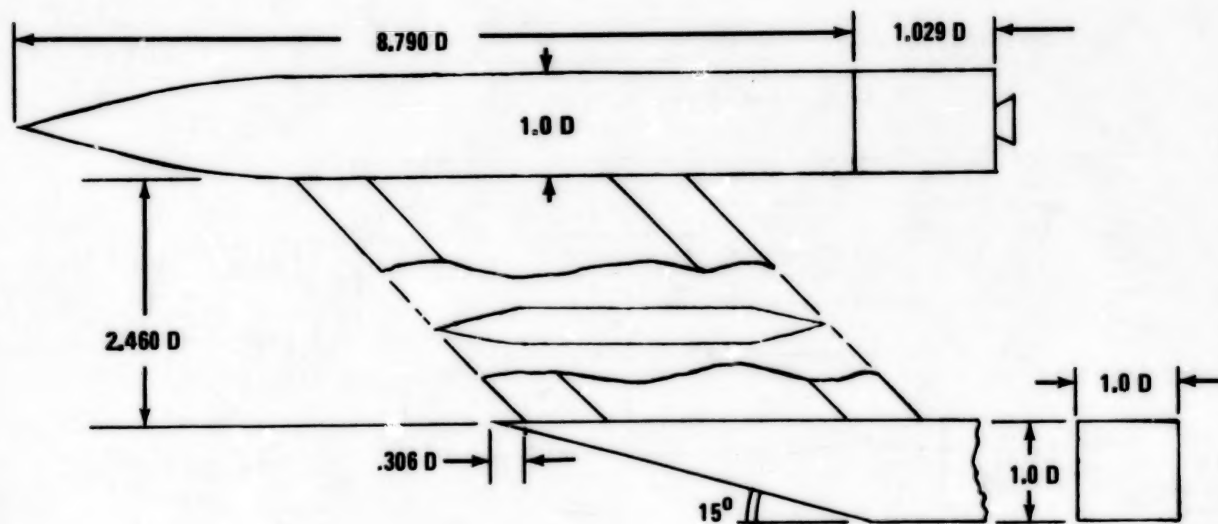


Figure 8. Nozzle summary.

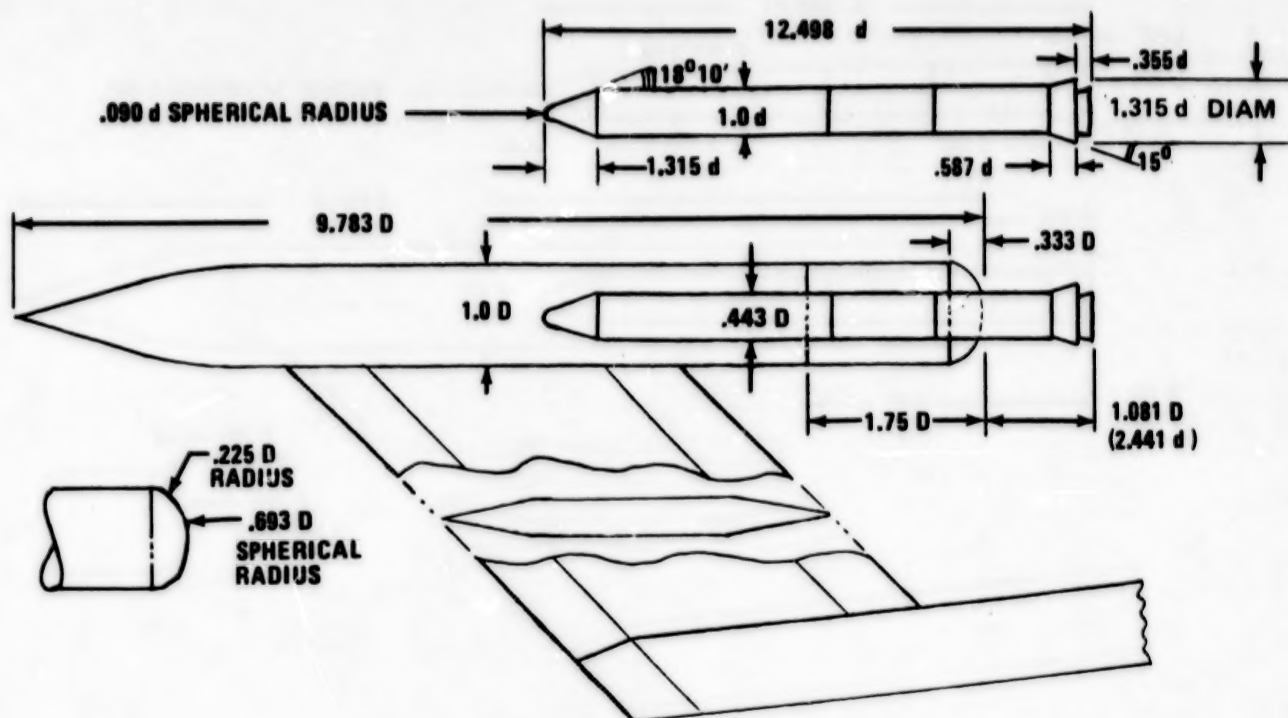


(a)  $B_1A_1 - D = 3.810 \text{ cm (1.500 in.)}$

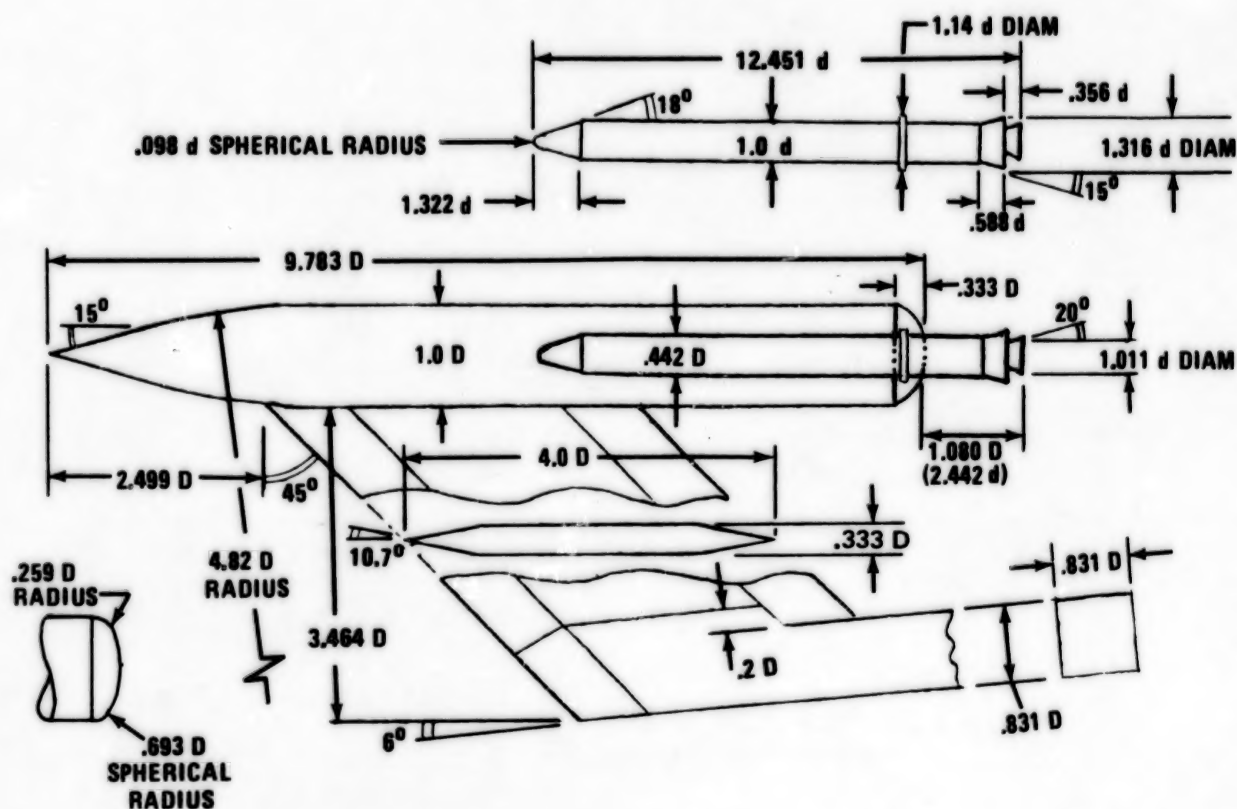


(b)  $B_1A_2 - D = 3.810 \text{ cm (1.500 in.)}$   
(SAME AS  $B_1A_1$  UNLESS NOTED)

Figure 9. Model details.



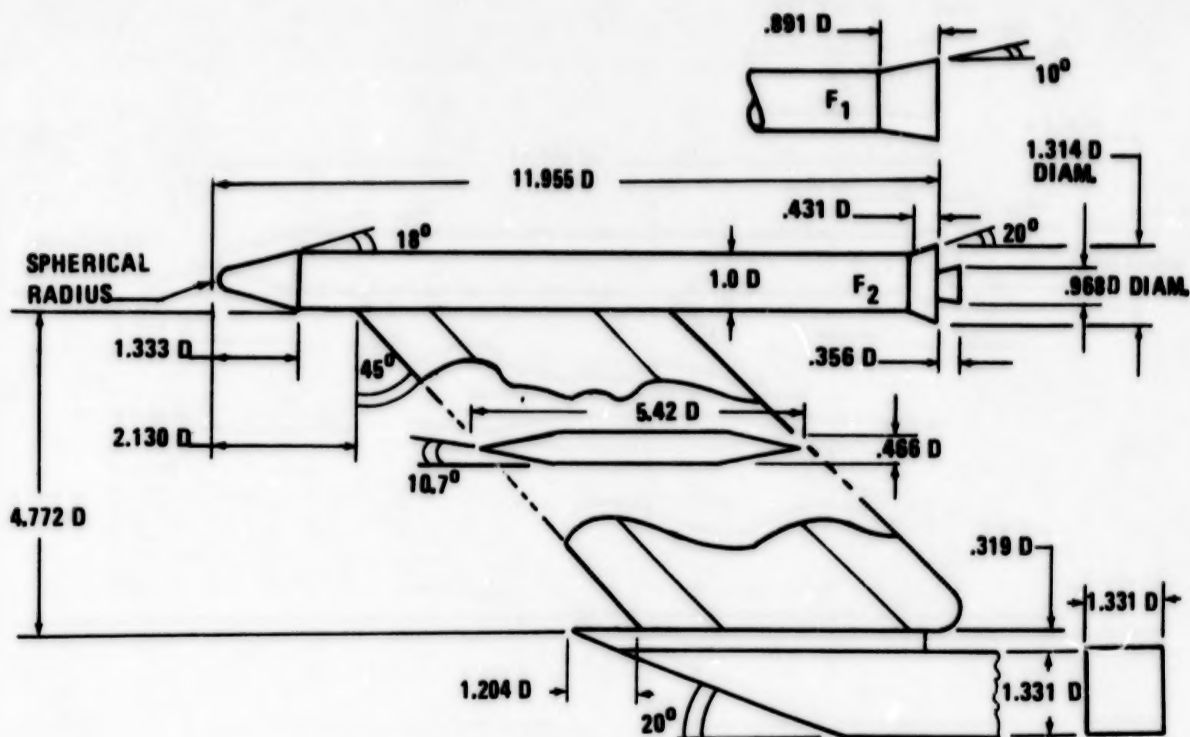
(c)  $B_1 A_3 S_1$  -  $D = 3.810$  cm (1.500 in.);  $d = 1.687$  cm (0.664 in.)  
(SAME AS  $B_1 A_1$  UNLESS NOTED)



(d)  $B_2 A_4 S_2$  -  $D = 18.334$  cm (7.218 in.);  $d = 8.108$  cm (3.192 in.)

Figure 9. (Continued).





(e)  $S_3F_1 - D = 2.385 \text{ cm (0.939 in.)}$

Figure 9. (Concluded).

Models  $B_1A_1$  and  $B_1A_2$  were approximately 0.4 percent scale of the Shuttle Orbiter and 1.0 percent scale of the Shuttle SRB. The design of model  $B_1A_1$  provided for ducting of heated high-pressure gases through the supporting strut to a plenum in the cylindrical portion and mounting within the afterbody ( $A_1$ ) various nozzle designs connecting to this plenum. There were up to 47 pressure and 6 temperature instrumentation leads within the model mold lines. Model  $B_1A_2$  was as similar to  $B_1A_1$  as practical. The only difference in external shape was a modest length increase to incorporate the solid-propellant-burning gas generator (discussed in Section III.C). However, the significantly different internal requirements led to a separate, complete model. As with model  $B_1A_1$ , various nozzle designs were mounted within the afterbody ( $A_2$ ). There were 12 pressure instrumentation leads plus ignition wires accommodated within the model mold lines.

TABLE 3. NOZZLE DIMENSIONS (SUMMARY)

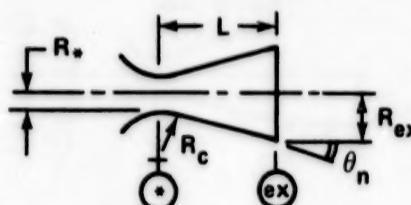
										
Nozzle	Design <sup>a</sup>				Measured					
	Gas	$\theta_n$ (deg)	$\epsilon$	$D_{ex}$ cm (in.)	$R_c/R_*$	$\theta_n$ (deg)	$\epsilon$	$D_{ex}$ cm (in.)	$D_*$ cm (in.)	$L$ cm (in.)
Classic Geometry										
1A	2	15	8.0	1.78 (0.700)	6.34	15.1	8.03	1.77 (0.697)	0.625 (0.246)	2.41 (0.948)
1B	3,4	15	8.0	1.78 (0.700)	3.63	14.9	7.88	1.77 (0.696)	0.630 (0.248)	2.26 (0.891)
1C	3,4	15	8.0	1.78 (0.700)	3.63	14.7	7.88	1.77 (0.696)	0.630 (0.248)	2.52 (0.994)
1D	3,4	15	8.0	1.78 (0.700)	3.59	15.0	7.92	1.77 (0.698)	0.630 (0.248)	2.30 (0.905)
1E	3,4	15	8.0	1.78 (0.700)	3.44	15.0	7.97	1.79 (0.706)	0.635 (0.250)	2.33 (0.918)
2A	3,4	15	4.0	1.78 (0.700)	3.79	15.2	4.05	1.78 (0.700)	0.884 (0.348)	1.88 (0.740)
2B	3,4	15	4.0	1.78 (0.700)	3.82	15.0	4.09	1.78 (0.700)	0.879 (0.346)	1.85 (0.730)



TABLE 3. (Continued)

Nozzle	Design <sup>a</sup>				Measured					
	Gas	$\theta_n$ (deg)	$\epsilon$	$D_{ex}$ cm (in.)	$R_c/R_*$	$\theta_n$ (deg)	$\epsilon$	$D_{ex}$ cm (in.)	$D_*$ cm (in.)	$L$ cm (in.)
3	1	25	3.5	1.78 (0.700)	4.04	25.0	3.58	1.78 (0.700)	0.942 (0.370)	1.34 (0.526)
4	1	35	6.5	1.78 (0.700)	3.64	35.1	6.51	1.77 (0.694)	0.691 (0.272)	1.18 (0.466)
5	1	35	3.5	1.78 (0.700)	0.86	34.9	3.52	1.78 (0.700)	0.947 (0.373)	0.73 (0.289)
SRB — Alone Class										
11	2	15	8.0	2.31 (0.909)	3.78	14.9	8.19	2.30 (0.907)	0.805 (0.317)	3.01 (1.186)
12	1	25	5.0	2.31 (0.909)	-	25.1	5.14	2.31 (0.911)	1.02 (0.402)	1.81 (0.711)
ET/SRB Class										
21A	5	20	3.1	7.86 (3.09)	2.80	20.4	3.10	7.88 (3.093)	4.46 (1.757)	5.72 (2.252)
21B	5	20	3.1	7.86 (3.09)	3.35	20.2	3.09	7.84 (3.088)	4.46 (1.757)	6.21 (2.446)

TABLE 3. (Continued)

Nozzle	Design <sup>a</sup>				Measured					
	Gas	$\theta_n$ (deg)	$\epsilon$	$D_{ex}$ cm (in.)	$R_c/R_*$	$\theta_n$ (deg)	$\epsilon$	$D_{ex}$ cm (in.)	$D_*$ cm (in.)	$L$ cm (in.)
22A	2	15	8.0	1.63 (0.643)	4.06	14.9	8.01	1.61 (0.634)	0.569 (0.224)	2.09 (0.821)
22B	2	15	8.0	1.63 (0.643)	3.97	15.0	7.99	1.61 (0.633)	0.569 (0.224)	2.08 (0.819)
23A	1	25	5.0	1.63 (0.643)	4.00	25.2	4.92	1.60 (0.632)	0.724 (0.285)	1.27 (0.500)
23B	1	25	5.0	1.63 (0.643)	4.00	24.9	4.92	1.60 (0.632)	0.724 (0.285)	1.25 (0.494)
24A	1	35	8.0	1.63 (0.643)	3.96	35.0	8.09	1.63 (0.640)	0.572 (0.225)	1.12 (0.440)
24B	1	35	8.0	1.63 (0.643)	4.00	35.3	8.04	1.62 (0.638)	0.572 (0.225)	1.11 (0.438)
Orbiter Class										
31A <sup>b</sup>	1	6	5.3	1.03 (0.404)	-	6.4	5.34	1.02 (0.402)	0.442 (0.174)	1.63 (0.640)
31B <sup>b</sup>	1	6	5.3	1.03 (0.404)	-	9.1	5.28	1.02 (0.402)	0.445 (0.175)	1.62 (0.639)
31C <sup>b</sup>	1	6	5.3	1.03 (0.404)	-	6.6	5.33	1.03 (0.404)	0.445 (0.175)	1.64 (0.647)

TABLE 3. (Concluded)

Nozzle	Design <sup>a</sup>				Measured					
	Gas	$\theta_n$ (deg)	$\epsilon$	$D_{ex}$ cm (in.)	$R_c/R_*$	$\theta_n$ (deg)	$\epsilon$	$D_{ex}$ cm (in.)	$D_*$ cm (in.)	$L$ cm (in.)
32A	1	10	4.0	1.03 (0.404)	4.12	10.1	4.06	1.02 (0.401)	0.505 (0.199)	1.53 <sup>c</sup> (0.603 <sup>c</sup> )
32B	1	10	4.0	1.03 (0.404)	4.10	10.0	4.00	1.02 (0.400)	0.508 (0.200)	1.53 <sup>c</sup> (0.603 <sup>c</sup> )
32C	1	10	4.0	1.03 (0.404)	4.08	10.1	3.96	1.02 (0.400)	0.511 (0.201)	1.51 <sup>c</sup> (0.595 <sup>c</sup> )
33A	2	15	8.0	1.03 (0.404)	5.42	14.8	8.30	1.04 (0.409)	0.361 (0.142)	1.37 (0.540)
33B	2	15	8.0	1.03 (0.404)	5.53	15.0	8.29	1.03 (0.406)	0.358 (0.141)	1.36 (0.537)
33C	2	15	8.0	1.03 (0.404)	5.53	15.1	8.29	1.03 (0.406)	0.358 (0.141)	1.37 (0.538)
34A	1	25	4.0	1.03 (0.404)	3.98	24.6	4.04	1.03 (0.404)	0.511 (0.201)	0.79 (0.311)
34B	1	25	4.0	1.03 (0.404)	4.07	25.4	4.16	1.03 (0.406)	0.505 (0.199)	0.79 (0.310)
34C	1	25	4.0	1.03 (0.404)	4.05	25.2	4.08	1.03 (0.404)	0.508 (0.200)	0.79 (0.312)

a. Design  $R_c/R_* = 4.0$  unless noted.

b. Contoured profile: see Table 4 for coordinates; design  $R_c/R_* = 3.1$ .

c. Calculated from other measured parameters.

NOTE: Measurements were rounded from English to nearest SI unit.

TABLE 4.  $N_{31}$  MEASURED DIMENSIONS

$X/R_*$ DESIGN	$R/R_*$ DESIGN			
	Design	Measured		
		A	B	C
0	1.000	0.992	0.997	0.997
0.274	1.004	1.007	-	1.006
0.558	1.020	1.025	1.004	1.022
0.843	1.048	1.052	1.027	1.051
1.128	1.090	1.086	1.061	1.087
1.413	1.143	1.141	1.108	1.140
1.698	1.213	1.204	1.169	1.206
1.983	1.284	1.274	1.243	1.280
2.268	1.360	1.351	1.316	1.355
2.553	1.433	1.426	1.390	1.431
2.838	1.504	1.494	1.463	1.502
3.123	1.575	1.565	1.534	1.566
3.408	1.641	1.634	1.594	1.639
3.693	1.706	1.696	1.667	1.703
3.978	1.769	1.756	1.731	1.765
4.262	1.827	1.814	1.788	1.824
4.547	1.883	1.871	1.847	1.880
4.832	1.935	1.927	1.901	1.933
5.117	1.986	1.977	1.952	1.986
5.402	2.034	2.023	2.000	2.032
5.687	2.081	2.067	2.048	2.079
5.972	2.124	2.111	2.092	2.123
6.257	2.163	2.149	2.136	2.164
6.542	2.202	2.188	2.173	2.197
6.827	2.237	2.222	2.211	2.230
7.112	2.271	2.259	2.249	2.269
7.397	2.303	2.291	2.294	2.302

Model  $B_1A_3S_1$  was approximately 0.5 percent scale of the Shuttle ET/SRB combination and used much of the model  $B_1A_1$  hardware. Afterbody  $A_3$  carried the heated high-pressure gases from the  $B_1$  plenum to secondary plenums in each of the attached model SRB's ( $S_1$ ). The aft end of  $S_1$  permitted the mounting of various nozzle designs. Pressure leads for SRB pressures were routed on the outside of  $S_1$  to a port in the side of  $B_1$ ; all other instrumentation leads were routed internally. Model  $B_2A_4S_2$  was approximately 2.2 percent scale of the Shuttle ET/SRB combination and 481.2 percent scale of the  $B_1A_3S_1$  model. The only gas ducting needed on this model was for a small amount of ignition gas to the SRB's ( $S_2$ ), detailed in Section III. C. Transducers for the 29 pressure leads were mounted within  $B_2$ . Pressure leads for the SRB base pressures were routed on the outside of  $S_2$  to a port in the side of  $B_2$ ; all other instrumentation leads were routed internally. Model  $S_3F$  was approximately 0.6 percent scale of the Shuttle SRB. The design of model  $S_3$  was similar to that of  $B_1$ , providing for ducting of heated high-pressure gases through the strut to a plenum in the cylindrical portion, which connected to the various nozzle designs mounted in the aft end. There were thirteen pressure leads and one temperature instrumentation lead accommodated within the model mold lines.

All of the various configuration buildups that were tested are defined in Table 5. Figure 10 shows installation photographs of some of the models in their respective wind tunnels.

### C. Description of Auxiliary Equipment

There were two significant pieces of auxiliary equipment developed specifically for this test program. The first was a high-pressure gas heater (Fig. 11). There were three close-coupled tanks. Pneumatically driven compressors pumped low pressure gas to the cold tank. This tank was used as the controlled supply for the heater tank, where the gas could be electrically heated as desired. A mixing valve was used to control the temperature of the gas delivered to the model. Gases could be delivered at  $13.8 \text{ MN/m}^2$  (2000 psia) and 600 K (1060°R), at flow rates up to 1.8 kg/s (4 lb/s) for 10 s. A small relief tank permitted operational flexibility, especially in preventing loss of expensive  $\text{CF}_4$  gas. The gas heater was used to provide heated high-pressure gases to models  $B_1A_1$ ,  $B_1A_3S_1$ , and  $S_3F$ . The gases used were air ( $G_1$ ) and  $\text{CF}_4$  ( $G_2$ ).

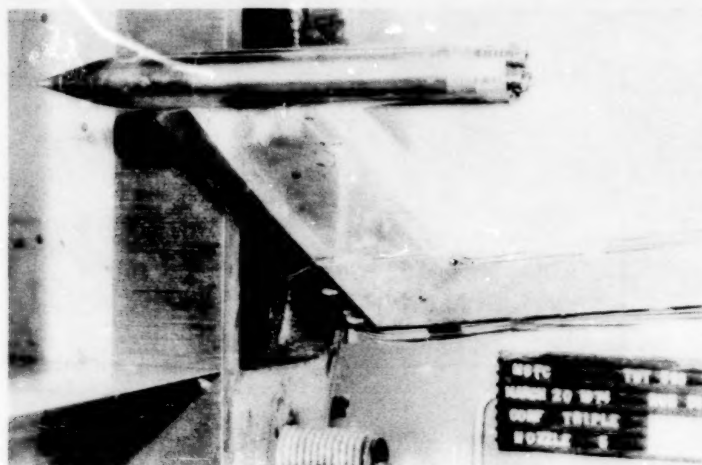


TABLE 5. CONFIGURATION BUILDUPS (SHOWING TEST NUMBERS)

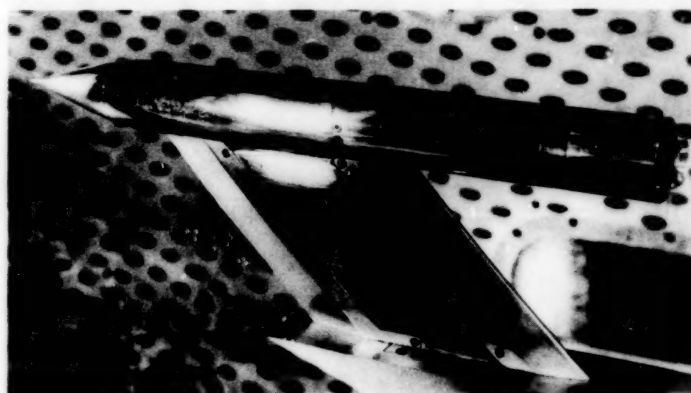
Body	Type	Nozzle	Gases				
			G <sub>1</sub> (Air)	G <sub>2</sub> (CF <sub>4</sub> )	G <sub>3</sub> (2% Aluminum)	G <sub>4</sub> (16% Aluminum)	G <sub>5</sub> (16% Aluminum)
B <sub>1</sub> A <sub>1</sub>	Classic     Orbiter	N <sub>1A</sub>	1 <sup>b</sup>	1 <sup>a</sup>			
		N <sub>3</sub>	1 <sup>a</sup>				
		N <sub>4</sub>	1 <sup>a</sup> , 3 <sup>b</sup>				
		N <sub>5</sub>	1, 3 <sup>b</sup>				
		N <sub>31</sub>	3 <sup>a</sup>				
		N <sub>32</sub>	3 <sup>a</sup>				
		N <sub>33</sub>	3	1 <sup>a</sup>			
		N <sub>34</sub>	1 <sup>a</sup>				
B <sub>1</sub> A <sub>2</sub>	Classic	N <sub>1B</sub>	2 <sup>b</sup>			2	
		N <sub>1C</sub>	2 <sup>b</sup>		2		
		N <sub>1D</sub>	6 <sup>b</sup>		6	6	
		N <sub>1E</sub>	6 <sup>b</sup>		6	6	
		N <sub>2A</sub>	2 <sup>b</sup>		2	2	
		N <sub>2B</sub>	6		6	6	
B <sub>1</sub> A <sub>3</sub> S <sub>1</sub>	ET/SRB	N <sub>22</sub>	7	7			
		N <sub>23</sub>	7				
		N <sub>24</sub>					
B <sub>2</sub> A <sub>4</sub> S <sub>2</sub>		N <sub>21</sub>					8
S <sub>3</sub> F <sub>1</sub>	SRB-Alone	N <sub>11</sub>		10 <sup>a</sup>			
		N <sub>12</sub>	10 <sup>a</sup>				
S <sub>3</sub> F <sub>2</sub>		N <sub>12</sub>	10 <sup>a</sup>				

- a. Also have nozzle calibration data — see Appendix C.  
b. Have only nozzle calibration data — see Appendix C.

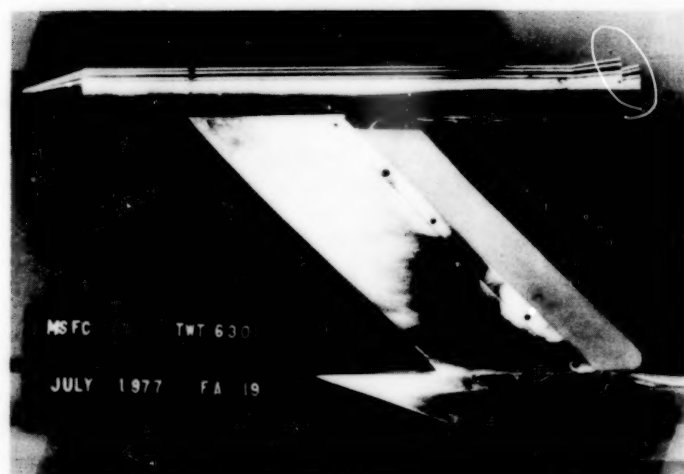




(a) CONFIGURATION  $B_1A_1$  IN MSFC 14 x 14 INCH TWT (TEST 1)



(b) CONFIGURATION  $B_1A_1$  IN AEDC-4T (TEST 6)



(c) CONFIGURATION  $S_3F_2$  IN MSFC 14 x 14 INCH TWT (TEST 10)

Figure 10. Model installations.

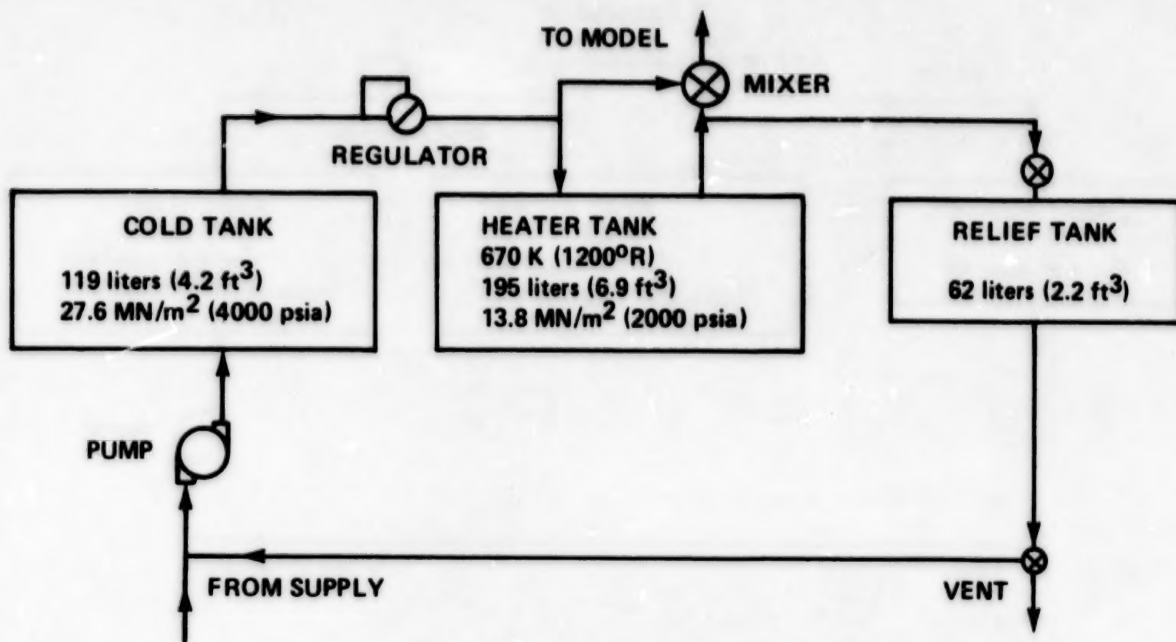


Figure 11. Heater schematic.

The second piece of auxiliary equipment developed was the gas generator used on Tests 2 and 6 to supply hot exhaust products from solid propellant combustion (Fig. 12). This device was developed for use with model  $B_1A_2$  [6] and was designed as an integral part of the model so that the combustion chamber outside wall formed the outer mold lines of the aerodynamic surface ( $B_1A_2$ ). Ignition was provided by a single, head-end mounted electric squib. It produced the exhaust products from the combustion of either a 2 percent aluminum CTPB formulation ( $G_3$ ) or a 16 percent aluminum PBAN formulation ( $G_4$ ). Details of these formulations and predicted specie are found in Reference 7. The model SRB ( $S_2$ ) used on Test 8 with model  $B_2A_4$  had been developed on an earlier test program described in Reference 8. For Test 8, a 16 percent aluminum PBAN formulation ( $G_5$ ) was used instead of the 15 percent aluminum PBAN formulation of Reference 8.

#### D. Description of Instrumentation

Static pressures on the model's external surface, base, and internal nozzle together with model chamber pressures were measured with remotely located conventional pressure transducers. Chamber temperature for the

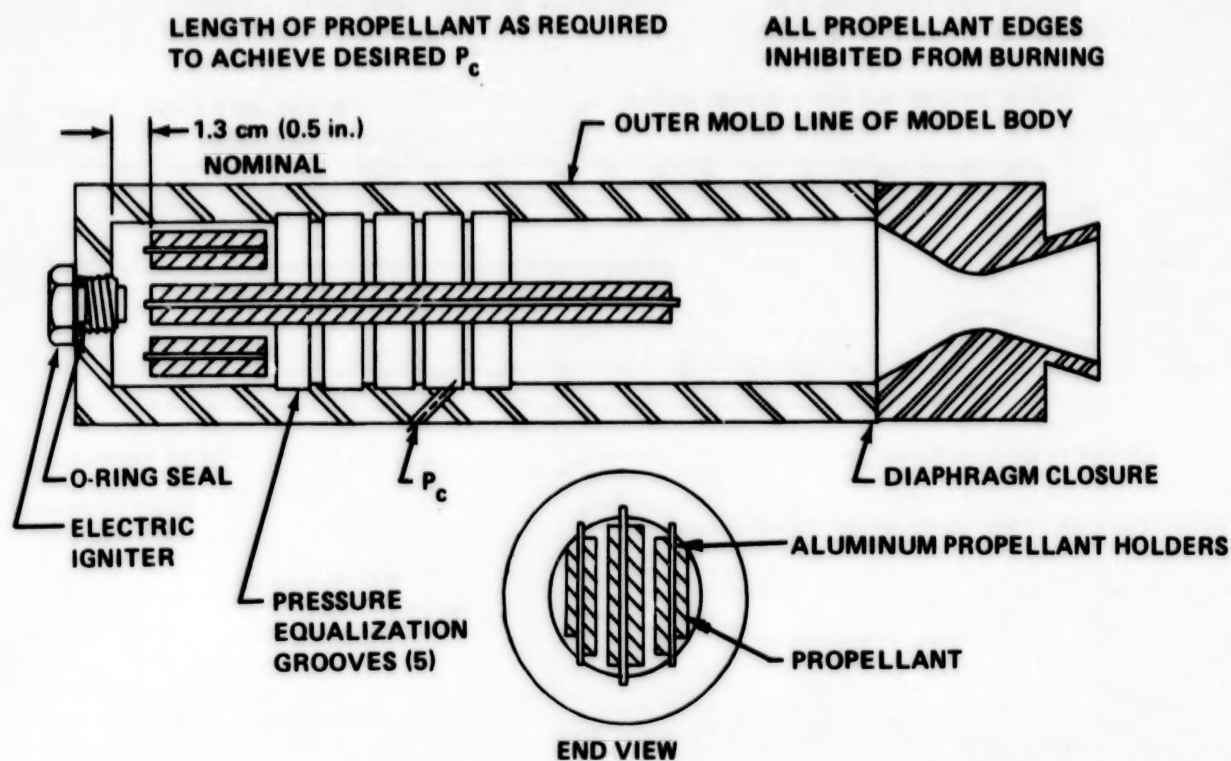


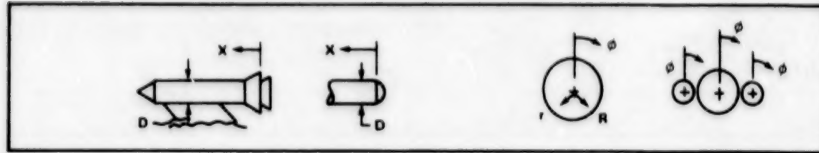
Figure 12. Gas generator design for Tests 2 and 6  
(adapted from Reference 6).

noncombustion gases was measured with a thermocouple total temperature probe located in the model stilling chamber. The external surface pressure orifice locations are presented in Table 6. The majority were located in the base regions or immediate vicinity. Model B<sub>1</sub>A<sub>1</sub> had a considerable number of orifices on the cylindrical portion of the body, but not all of these were monitored on every test.

All of the nozzle internal surface pressure orifice locations used in wind-on tests are presented in Table 7. For Tests 2, 6, 8, and 10, each nozzle had three orifices monitored at different axial positions. However, for Tests 1, 3, and 7, only one tap per nozzle was monitored. Some of the nozzles used with the classic-geometry body in Test 1 had a greater number of orifices (used during the nozzle calibration testing), but only one was monitored for wind-on runs.

The estimated errors associated with all of the pressure instrumentation are presented in Table 8.

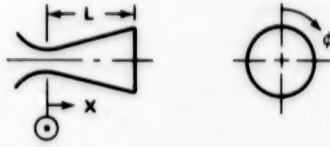
**TABLE 6. BASE AND BODY PRESSURE  
INSTRUMENTATION LOCATIONS**



Base Region ( $X/D \approx 0$ )						Body Region ( $r/R = 1.0$ )				
Configuration Class	Model	$r/R$				Configuration Class	Model	$X/D$		
		$\phi = 0^\circ$	$\phi = 60^\circ$	$\phi = 180^\circ$				$\phi = 0^\circ$	$\phi = 60^\circ$	$\phi = 180^\circ$
Classic	B <sub>1</sub> A <sub>1</sub>	0.52 0.84	0.52 0.84	0.84		Classic and Orbiter	B <sub>1</sub> A <sub>1</sub>	0.04 0.22 0.40 0.58 0.76 0.94 1.12 1.30 1.48 1.84 2.20 2.56 2.92 3.28	0.04 0.22 0.40 0.58 0.76 0.94 1.12 1.30 1.48 2.20 2.92	0.02    0.76     2.20
	B <sub>1</sub> A <sub>2</sub>	0.52 0.84	0.52 0.84							
Orbiter	B <sub>1</sub> A <sub>1</sub>	0 0.84	(0) 0.52 0.84	(0) 0.931 0.992						
ET		$\phi = 0^\circ$	$\phi = 15^\circ$	$\phi = 45^\circ$	$\phi = 90^\circ$					
	A <sub>3</sub> , A <sub>4</sub>	0 0.531 0.931 0.992	(0) 0.52 0.879 0.969	(0) 0.531 0.931 0.992	(0) 0.531 0.931 0.992					
SRB		$\phi = 0^\circ$	$\phi = 90^\circ R$ 85° L	$\phi = 275^\circ R$ 270° L	$\phi = 315^\circ$		Classic	B <sub>1</sub> A <sub>2</sub>	0.03 0.33 0.67	
	S <sub>1</sub>	N <sub>22</sub>	R	0.843	0.843		ET <sup>a</sup>	B <sub>1</sub> A <sub>3</sub>	0.083 0.250 0.583	
			L	0.843	0.843					
		N <sub>23</sub>	R	0.797	0.797		B <sub>2</sub> A <sub>4</sub>	0.017 0.052 0.121		
		L	0.797	0.797	0.797					
	N <sub>24</sub>	R	0.742	0.742	0.742		SRB	S <sub>3</sub> F <sub>1</sub>	0.121 0.360 0.599 0.759 1.002 1.246	
		L	0.742	0.742	0.742					
		$\phi = 0^\circ$	$\phi = 90^\circ$	$\phi = 270^\circ R$ 274° L	$\phi = 315^\circ$					
	S <sub>2</sub>	R	0.833	0.833	0.833					
	L	0.833	0.833	0.833	0.833					
	S <sub>3</sub>	$\phi = 0^\circ$	$\phi = 90^\circ$	$\phi = 270^\circ$						
		0.810	0.810	0.810			S <sub>3</sub> F <sub>2</sub>	0.109 0.190 0.271 0.385 0.466 0.547		

a. Measured from cylinder/dome tangent point.

TABLE 7. NOZZLE PRESSURE INSTRUMENTATION LOCATIONS  
USED IN WIND-ON TESTS



Nozzle	Upstream Tap				Middle Tap				Downstream Tap			
	Tap No.	$\phi$ (deg)	X/L	A/A*	Tap No.	$\phi$ (deg)	X/L	A/A*	Tap No.	$\phi$ (deg)	X/L	A/A*
Classic Geometry												
1A									47	210	0.942	7.36
1B	2	180	0.155	1.40	3	120	0.569	3.92	4	240	0.943	7.27
1C	2	180	0.236	1.44	3	120	0.622	4.04	4	240	0.952	7.33
1D	2	180	0.181	1.47	3	120	0.608	4.19	4	240	0.963	7.53
1E	2	180	0.191	1.52	3	120	0.612	4.25	4	240	0.967	7.62
2A	2	180	0.268	1.36	3	120	0.644	2.56	4	240	0.942	3.78
2B	2	180	0.304	1.53	3	120	0.655	2.67	4	240	0.959	3.91
3									47	210	0.895	3.06
4									47	210	0.938	5.77
5									47	210	0.806	2.78
SRB-Alone Class												
11	3	180	0.557	3.91	2	180	0.795	6.00	1	180	0.937	7.66
12	3	180	0.686	3.05	2	180	0.812	3.83	1	180	0.932	4.64
ET/SRB Class												
21A		180	0.661	2.07		180	0.815	2.51		180	0.976	3.02
21B		180	0.681	2.04		180	0.828	2.50		180	0.973	2.99
22A	22	180	0.106	1.18	23	180	0.533	3.69	24	180	0.940	7.37
22B	32	180	0.114	1.19	33	180	0.529	3.62	34	180	0.943	7.36
23A	22	180	0.678	2.84	23	180	0.796	3.54	24	180	0.916	4.32
23B	32	180	0.680	2.90	33	180	0.798	3.58	34	180	0.921	4.37
24A	22	180	0.430	1.64	23	180	0.691	3.99	24	180	0.907	6.70
24B	32	180	0.436	1.64	33	180	0.680	3.82	34	180	0.902	6.58
Orbiter Class												
31B									47	210	0.940	4.96
31C									48	150	0.941	5.27
32B									47	210	0.923	3.68
32C									48	150	0.928	3.67
33B									47	210	0.885	6.99
33C									48	150	0.879	6.92
34B									47	210	0.810	3.09



TABLE 8. ESTIMATED INSTRUMENTATION ERRORS

Test \ Site	MSFC TWT				AEDC 4T		Ames 11-Foot
	1	2	3	10	6	7	8
SI Units — Tolerances ( $\pm \text{kN/m}^2$ )							
Tunnel: P P <sup>t</sup> q M	0.34 0.10	0.34 0.10	0.34 0.10	0.34 0.10	0.37 <sup>a</sup> 0.85 <sup>a</sup> 0.10 <sup>a</sup>	0.51 <sup>a</sup> 1.28 <sup>a</sup> 0.14 <sup>a</sup>	
Model base and surface	0.78 <sup>b</sup> 0.26 <sup>c</sup>	2.61	0.15	0.78 <sup>b</sup> 0.26 <sup>c</sup>	0.17	0.046 <sup>a,m</sup>	0.78
Chamber	130.0	110.0	21.0 <sup>d</sup> 5.17 <sup>e</sup> 1.55 <sup>f</sup>	130.0	63.0	55.8 7.7 <sup>a,m</sup>	52.0
Nozzles All g h i  1A <sup>g</sup> 1A <sup>h</sup> , 3, 5, 32, 34 1A <sup>i</sup> , 4, 33 4 <sup>j</sup> , 5, 31 <sup>j</sup> , 32 <sup>j</sup> , 33 <sup>j</sup> 4 <sup>k</sup> , 5 <sup>k</sup> , 31 <sup>k</sup> , 32 <sup>k</sup> , 33 <sup>k</sup>	26.2 7.58 1.57	24.0	1.55 0.31	2.6	17.9 8.96 2.76	13.5 1.38 0.69	2.6
U.S. Customary Units — Tolerances ( $\pm \text{psi}$ )							
Tunnel: P P <sup>t</sup> q M	0.050 0.015	0.050 0.015	0.050 0.015	0.050 0.015	0.054 <sup>a</sup> 0.124 <sup>a</sup> 0.015 <sup>a</sup>	0.074 <sup>a</sup> 0.186 <sup>a</sup> 0.020 <sup>a</sup>	
Model base and surface	0.113 <sup>b</sup> 0.038 <sup>c</sup>	0.378	0.022	0.113 <sup>b</sup> 0.038 <sup>c</sup>		0.046 <sup>a,m</sup>	0.113
Chamber	18.75	16.0	3.0 <sup>d</sup> 0.750 <sup>e</sup> 0.225 <sup>f</sup>	18.75	9.2	8.1 7.7 <sup>a,m</sup>	7.5
Nozzles All g h i  1A <sup>g</sup> 1A <sup>h</sup> , 3, 5, 32, 34 1A <sup>i</sup> , 4, 33 4 <sup>j</sup> , 5, 31 <sup>j</sup> , 32 <sup>j</sup> , 33 <sup>j</sup> 4 <sup>k</sup> , 5 <sup>k</sup> , 31 <sup>k</sup> , 32 <sup>k</sup> , 33 <sup>k</sup>	3.75 1.13 0.227	3.47	0.225 0.045	0.375	2.59 1.25 0.36	2.0 0.2 0.1	0.375

- a. Tolerance depends on  $M_\infty$ ; maximum value shown.  
b.  $M < 2.0$ .  
c.  $M < 3.5$ .  
d.  $3.4 < P_c < 13.8 \text{ MN/m}^2$  ( $500 < P_c < 2000 \text{ psi}$ ).  
e.  $1.0 < P_c < 3.4 \text{ MN/m}^2$  ( $150 < P_c < 500 \text{ psi}$ ).  
f.  $P_c < 1.0 \text{ MN/m}^2$  ( $P_c < 150 \text{ psi}$ ).  
g. Upstream tap.

- h. Middle tap.  
i. Downstream tap.  
j. "High"  $P_c$  range.  
k. "Low"  $P_c$  range.  
l. "Low"  $P_c$  range for downstream tap.  
m. Tolerance in  $\pm P/P_\infty$ .

## IV. TEST CONDITIONS

### A. Wind-On Tests

The equipment previously described was assembled in various combinations for a series of tests (Table 5). Test 1 was the initial exploratory and feasibility investigation, using air ( $G_1$ ) and  $CF_4$  ( $G_2$ ). Test 2 was a limited extension of one of the Test 1 configurations (classic geometry) into hot exhausts from solid propellant combustion,  $G_3$  and  $G_4$ . Test 3 was another extension of a different Test 1 configuration (Oribter class) into small-size plumes (primarily via nozzles with smaller exit wall angles than on Test 1) and limited to transonic speeds and air ( $G_1$ ). Test 6 was an extension of Test 2 into the transonic regime. Test 7 introduced a different body geometry (ET/SRB class) with  $G_1$  and  $G_2$ . Test 8 was an extension of the Test 7 study of hot exhausts from solid propellant combustion. This model was considerably larger only to utilize existing hardware with proven capability for simultaneous ignition of the two rockets. The propellant formulations used in Tests 2 and 6 were not readily available in adequate quantity; consequently, a formulation ( $G_5$ ) was used that was very similar to  $G_4$ . Test 10 was an inquiry into the applicability of the conclusions reached with the classic geometry tests to the flare configuration of the SRB, using  $G_1$  and  $G_2$ . Some of the tests using air ( $G_1$ ) were conducted at chamber pressures and temperatures which resulted in condensation within the nozzles or in the initial plume expansions. Such data were retained, although their utility or applicability to devising a simulation parameter may be questionable.

Table 9 presents a quality summary of the previously mentioned tests. From the table it can be seen that the bulk of the data were acceptable. Table 10 summarizes the conditions of the tests. The specific values of the model chamber and tunnel freestream parameters are given in Appendix A, and the complete set of base, body, and nozzle pressures are given in Appendix B.

### B. Nozzle Calibrations

The nozzle calibration activities were incorporated to quantify the operation of each nozzle under controlled conditions. The MSFC 14 × 14 Inch TWT was used. Nozzles designed for use with air and  $CF_4$  were calibrated as mounted for the wind-on tests, using the high pressure gas heater for air supply. Nozzles

TABLE 9. TEST QUALITY SUMMARY

Test	Data Usability
1 (MA10F)	Acceptable, some discrepancies in nozzle wall pressures
3 (FA11)	Acceptable, some discrepancies in nozzle wall pressures
6 (FA22)	Low confidence in $P_c$ values due to propellant contamination
7 (FA20)	Acceptable
2 (MA11F)	Subsonic and low supersonic data unacceptable due to tunnel control being too slow to respond to plume-induced pressure transient, before motor termination; quality of pressure transducers questionable for supersonic data
8 (FA23)	Transonic portion acceptable; unresolved question concerning which nozzle was used on left and right SRB
10 (FA19)	Acceptable for qualitative comparisons within this data set, but tunnel interference precludes quantitative comparison with data from other sources

TABLE 10. TEST CONDITION SUMMARY

Configuration Class	Model	Nozzle	Gas	$\delta_{jb}$	$M_\infty$	Test Series
				0° 20° 40° 60°	0.5 1.0 1.5 2.0 3.5	
Classic	B <sub>1</sub> A <sub>1</sub>	3	1			1
		4	1			1
		5	1			1
		1A	2			1
	B <sub>1</sub> A <sub>2</sub>	1B, 1C	3,4			2
		1D, 1E	3,4			6
2A		3,4			2	
2B		3,4			6	
Orbiter	B <sub>1</sub> A <sub>1</sub>	31	1			3
		32	1			3
		33	1			3
		34	1			1
		33	2			1
ET/SRB	B <sub>1</sub> A <sub>3</sub> S <sub>1</sub>	23	1			7
		24	1			7
		22	2			7
	B <sub>2</sub> A <sub>4</sub> S <sub>2</sub>	21	5			8
SRB	S <sub>3</sub> F <sub>1</sub>	12	1			10
		11	2			10
	S <sub>3</sub> F <sub>2</sub>	12	1			10

designed for use with solid propellant exhausts were calibrated with a special test section. Pressures in the chamber surrounding the specimen nozzle and air supplied to the nozzle chamber were controlled to levels required to achieve a specified value of  $P_c / P_{amb}$ . Instrumentation was the same as that used for the basic wind-on tests. The specific values of the ambient and model chamber conditions are given in Appendix C.

## V. SUMMARY OF DATA

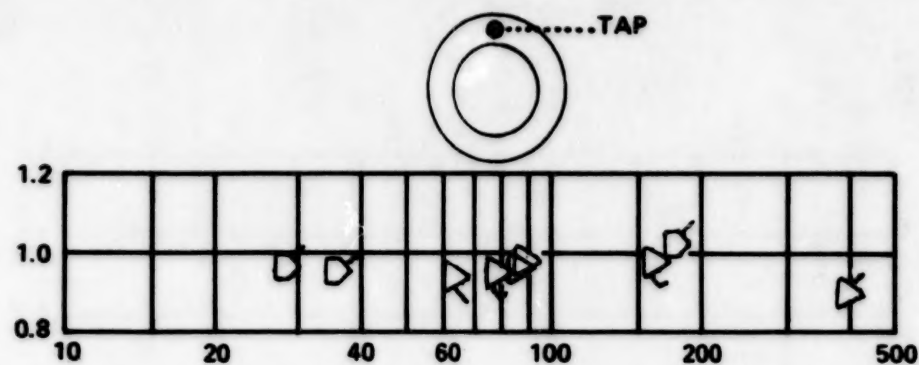
A considerable amount of data was acquired during this test program. The bulk of the data is presented in the appendices. Appendix A gives the tunnel freestream and model chamber conditions, together with the one base pressure value for the location judged to be most representative for the respective body geometry type. Appendix B gives all of the base, body, and nozzle pressure data. Nozzle calibration data are presented in Appendix C. The test data reports from which all data were taken are listed in Appendix D.

From the beginning of this test program it was envisioned that a plume simulation would be required to cover a spectrum of flowfields (from those generated by plumes small enough that base pumping existed through sizes where flow was separated over the vehicle afterbody). However, as the Space Shuttle program developed it became evident that the SSLV would not have significant flow separation during that portion of flight involving significant dynamic pressure. Therefore, emphasis on the region of large plume sizes which would induce flow separation was reduced. There are some data included in this document where flow was separated over an afterbody, but the amount of flow separation and the range of variables investigated was not sufficient for a thorough analysis. The most important contribution to the literature is the base pressure results. Therefore, in summarizing the results only base pressure data will be considered.

### A. Basic Pressure Data

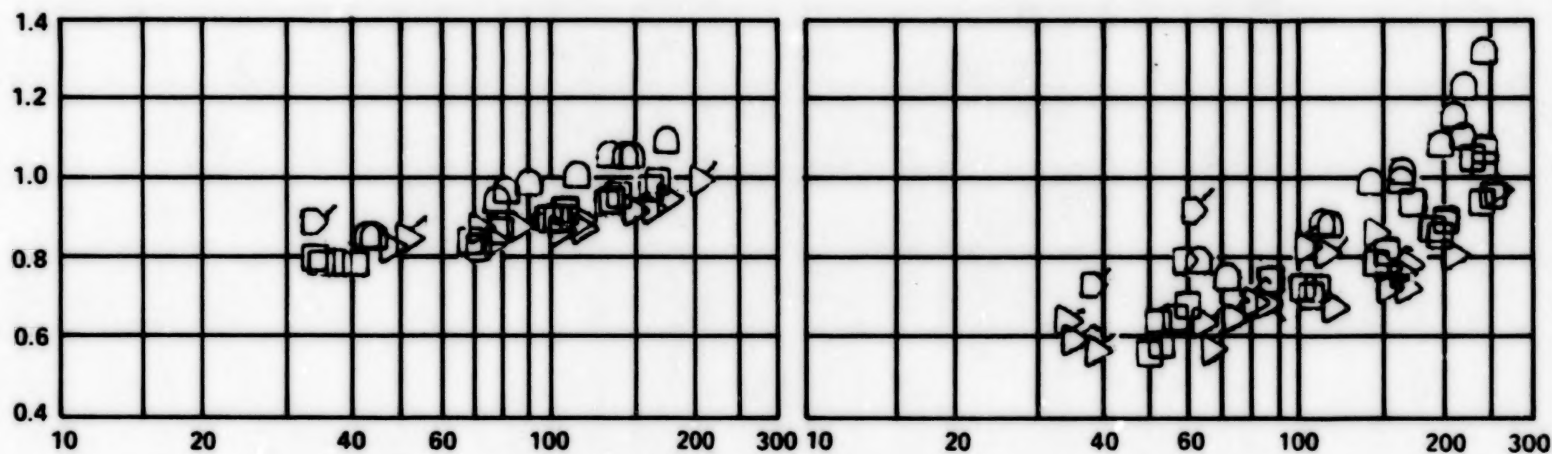
To provide an overview of the data, the basic base pressure data have been plotted as  $P_b / P_\infty$  versus  $P_c / P_\infty$  (Figs. 13 through 17). The data are presented by configuration class with data for the various nozzle/gas pairs on each plot. This type presentation allows a quick overview of the range of base pressure available and the relationship of any particular nozzle to the other nozzles in affecting base pressure. The data in these plots are tabulated in Appendix A, together with the wind tunnel freestream and model chamber conditions.

BASE PRESSURE RATIO,  $P_b/P_\infty$



NOZZLE	GAS			
	1	2	3	4
1		▷	▷	▷
2			▷	▷
3	◊			
4	◊			
5	◊			

(a)  $M_\infty \approx 0.5$



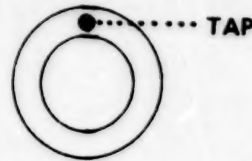
(b)  $M_\infty \approx 0.9$

CHAMBER PRESSURE RATIO,  $P_c/P_\infty$

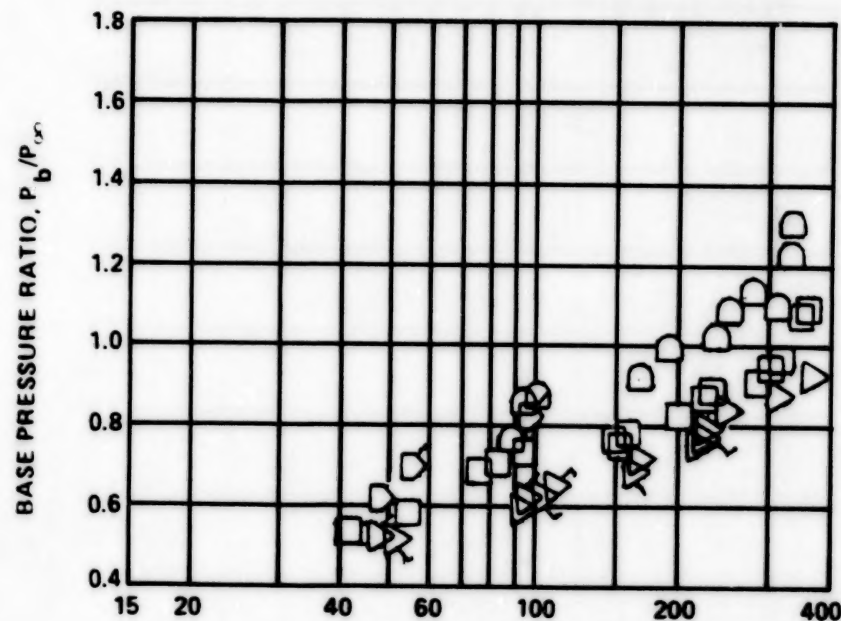
(c)  $M_\infty \approx 1.2$

Figure 13. Base pressure trends for classic geometry ( $B_1A_1$ ,  $B_1A_2$ ).

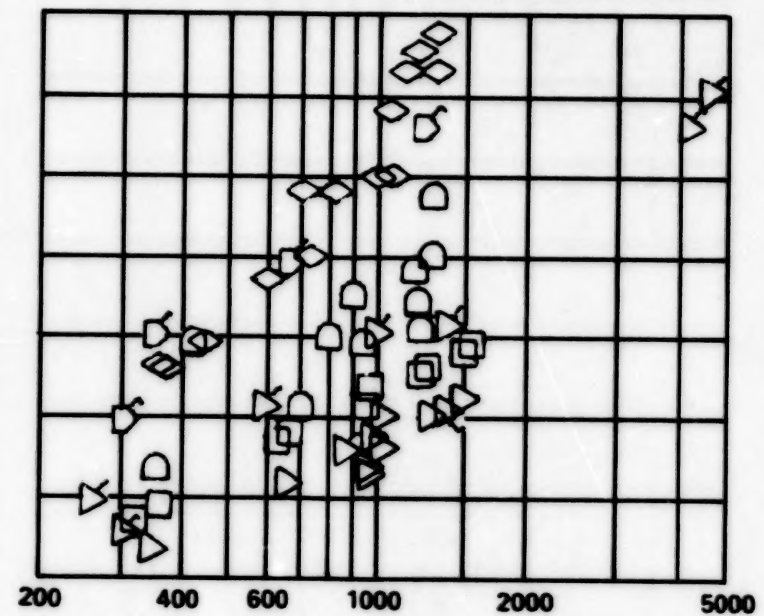




NOZZLE	GAS			
	1	2	3	4
1		▷	◂	◂
2			◂	◂
3	◁			
4	◁			
5	◊			



(d)  $M_\infty \approx 1.5$



(e)  $M_\infty \approx 3.5$

Figure 13. (Concluded).

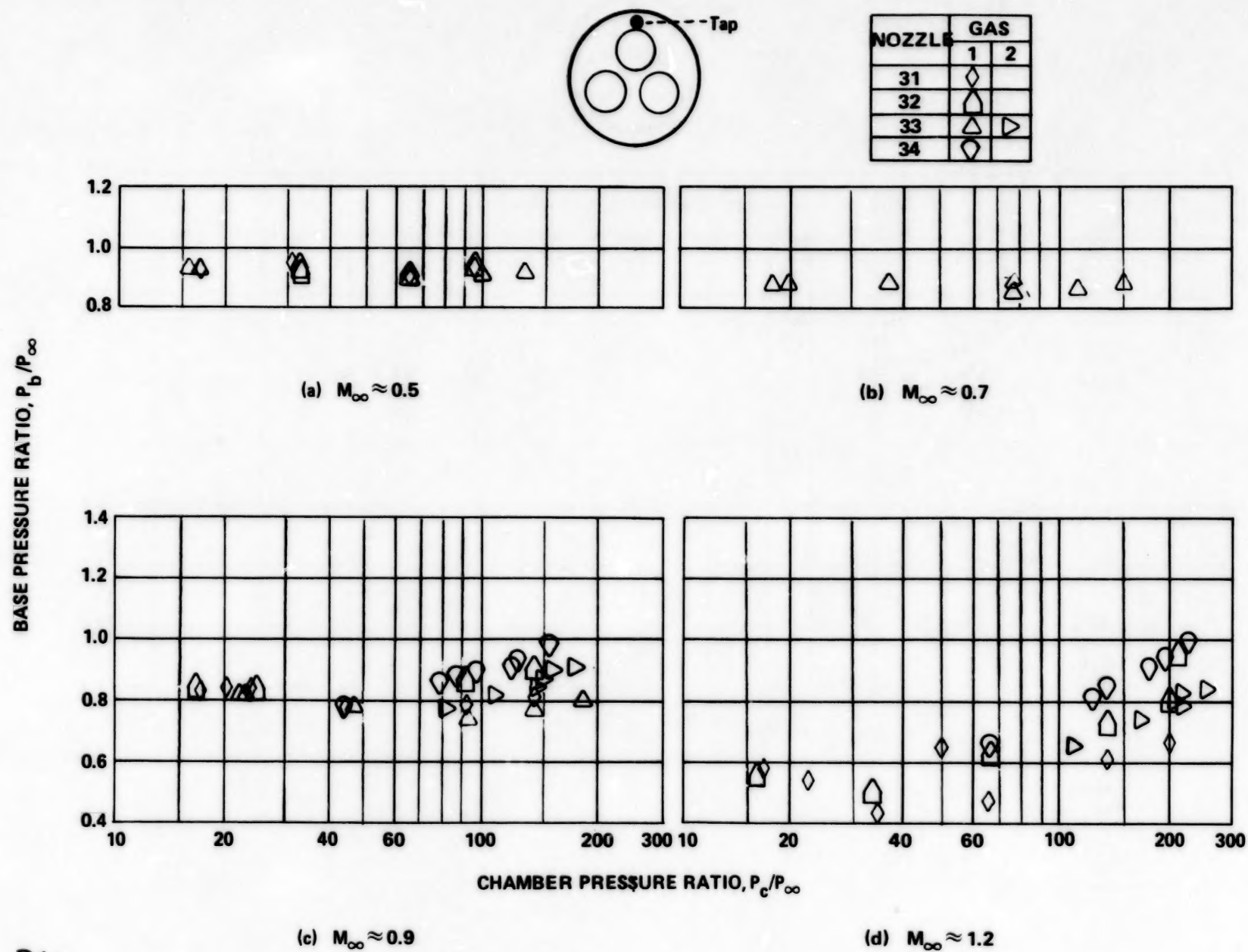
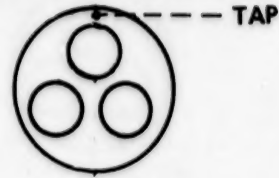
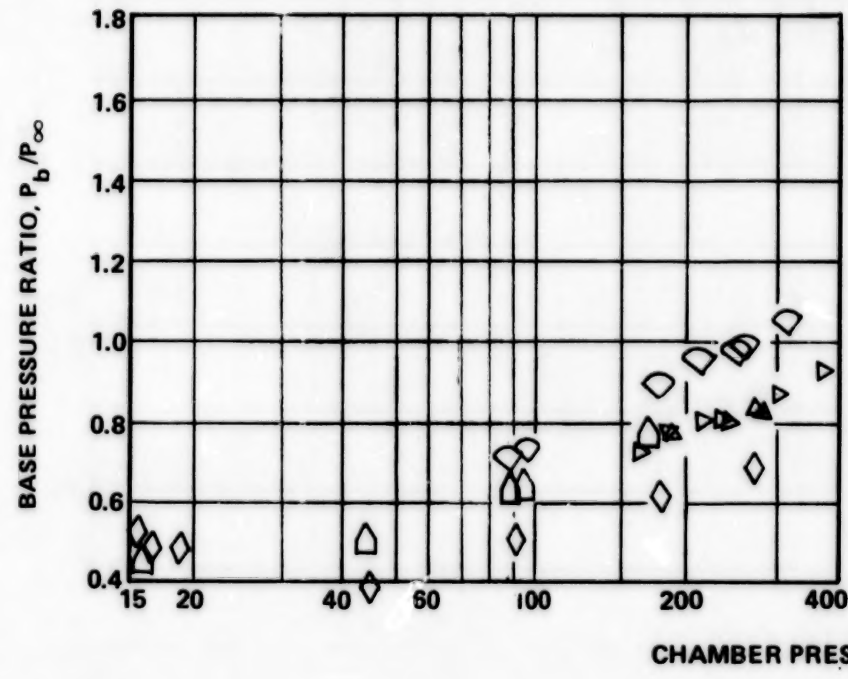


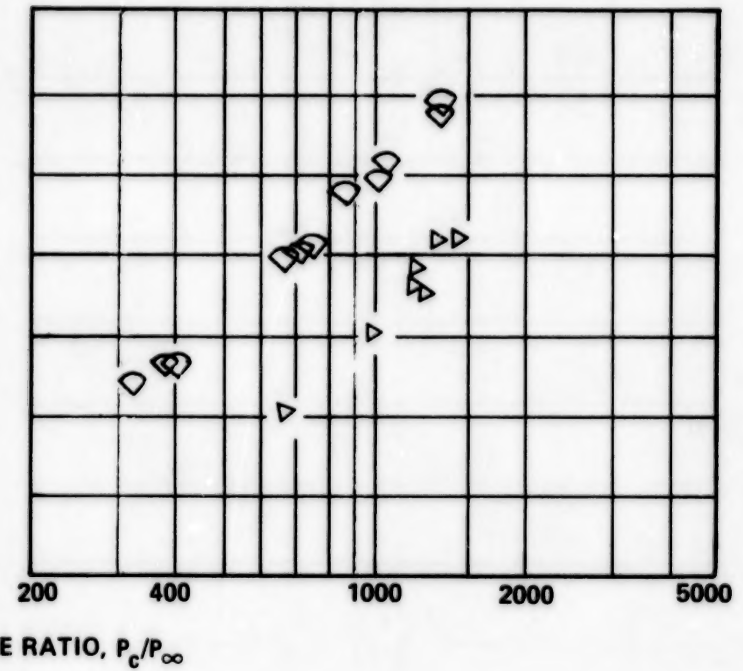
Figure 14. Base pressure trends for Orbiter class ( $B_1A_1$ ).



NOZZLE	GAS	
	1	2
31	◇	
32	△	
33	△	▷
34	◇	



(e)  $M_\infty \approx 1.5$



(f)  $M_\infty \approx 3.5$

Figure 14. (Concluded).

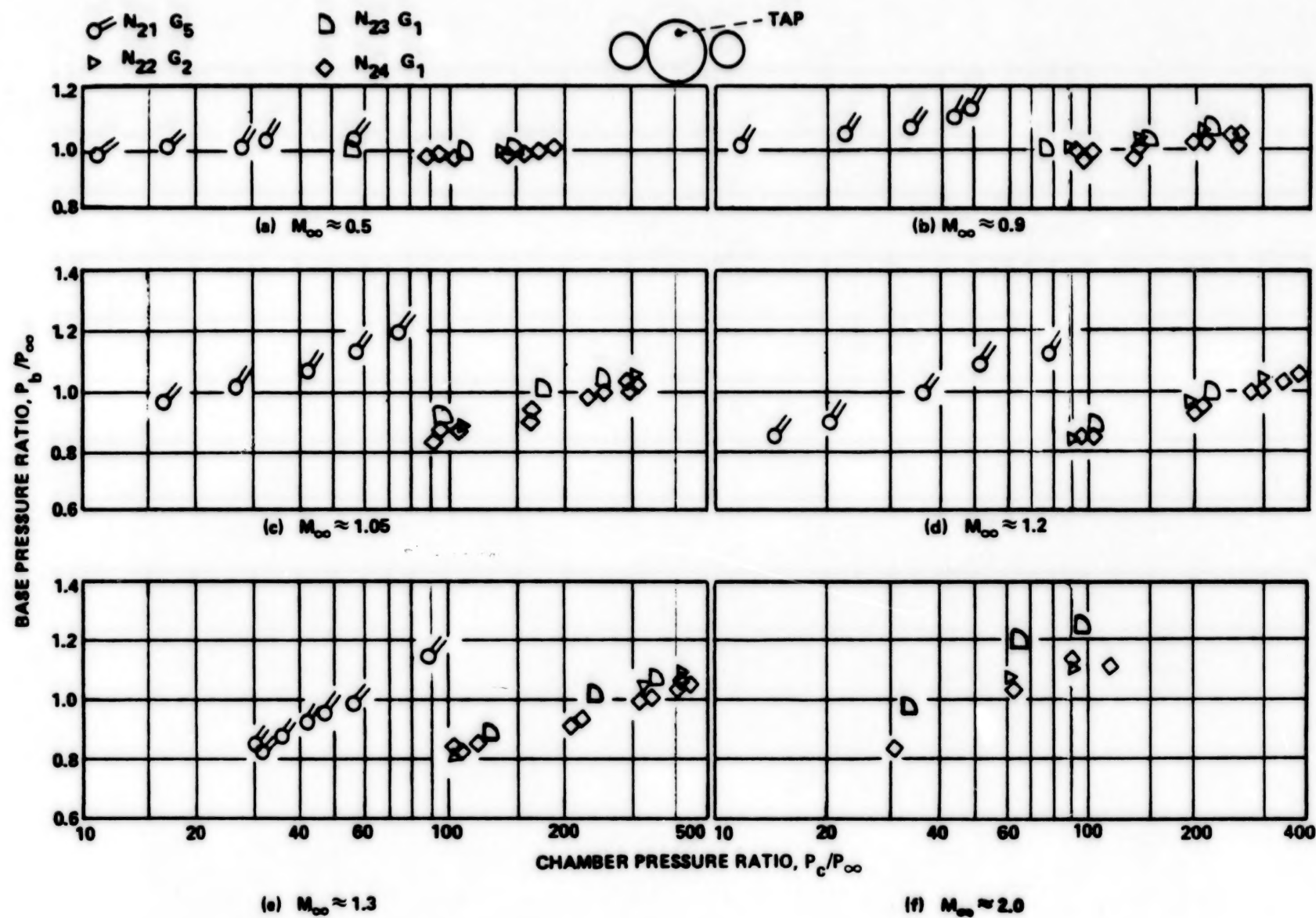


Figure 15. Base pressure trends for ET tap on ET/SRB class ( $B_1A_3S_1$ ,  $B_2A_4S_2$ ).

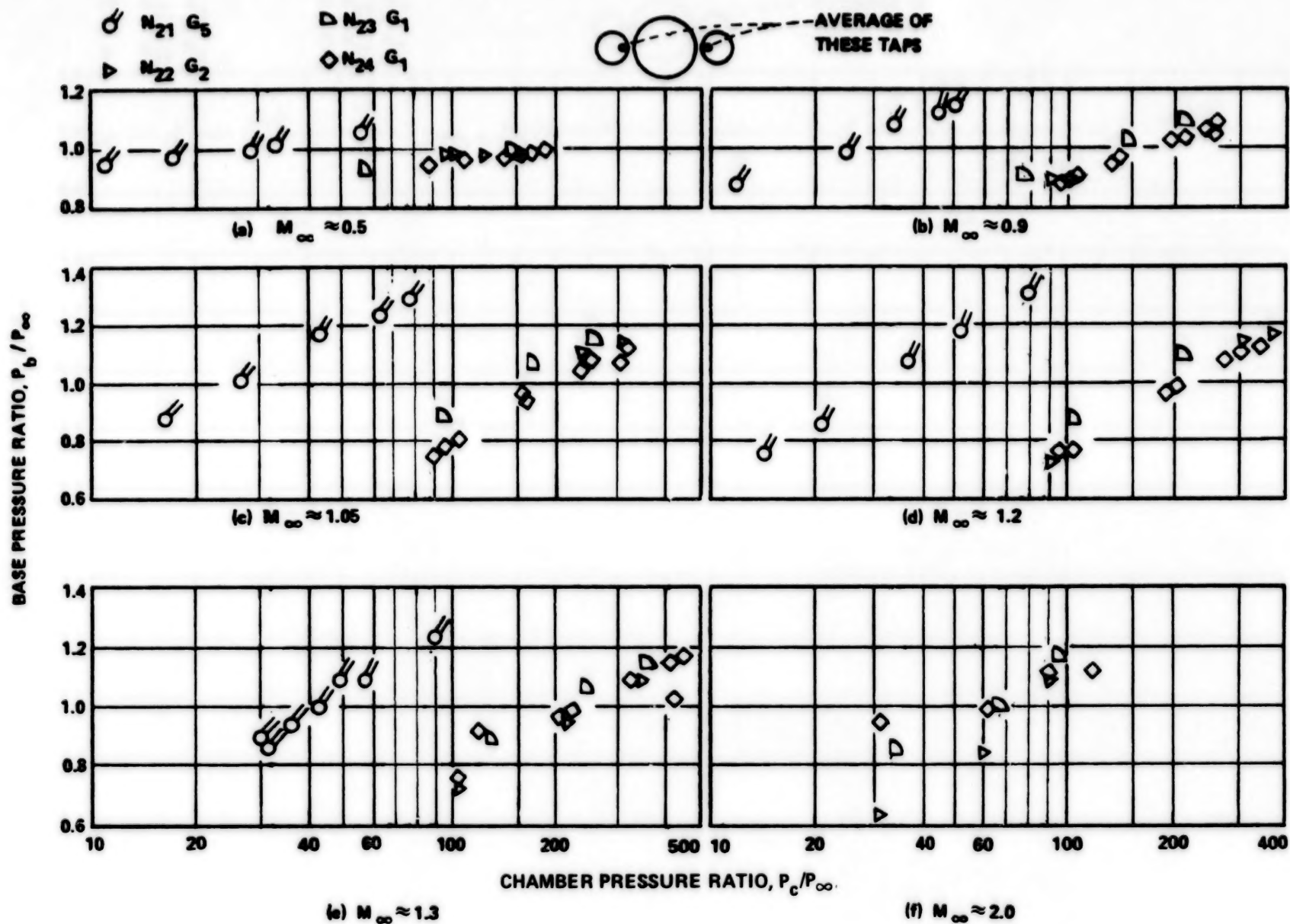


Figure 16. Base pressure trends for SRB tap on ET/SRB class ( $B_1A_3S_1$ ,  $B_2A_4S_2$ ).



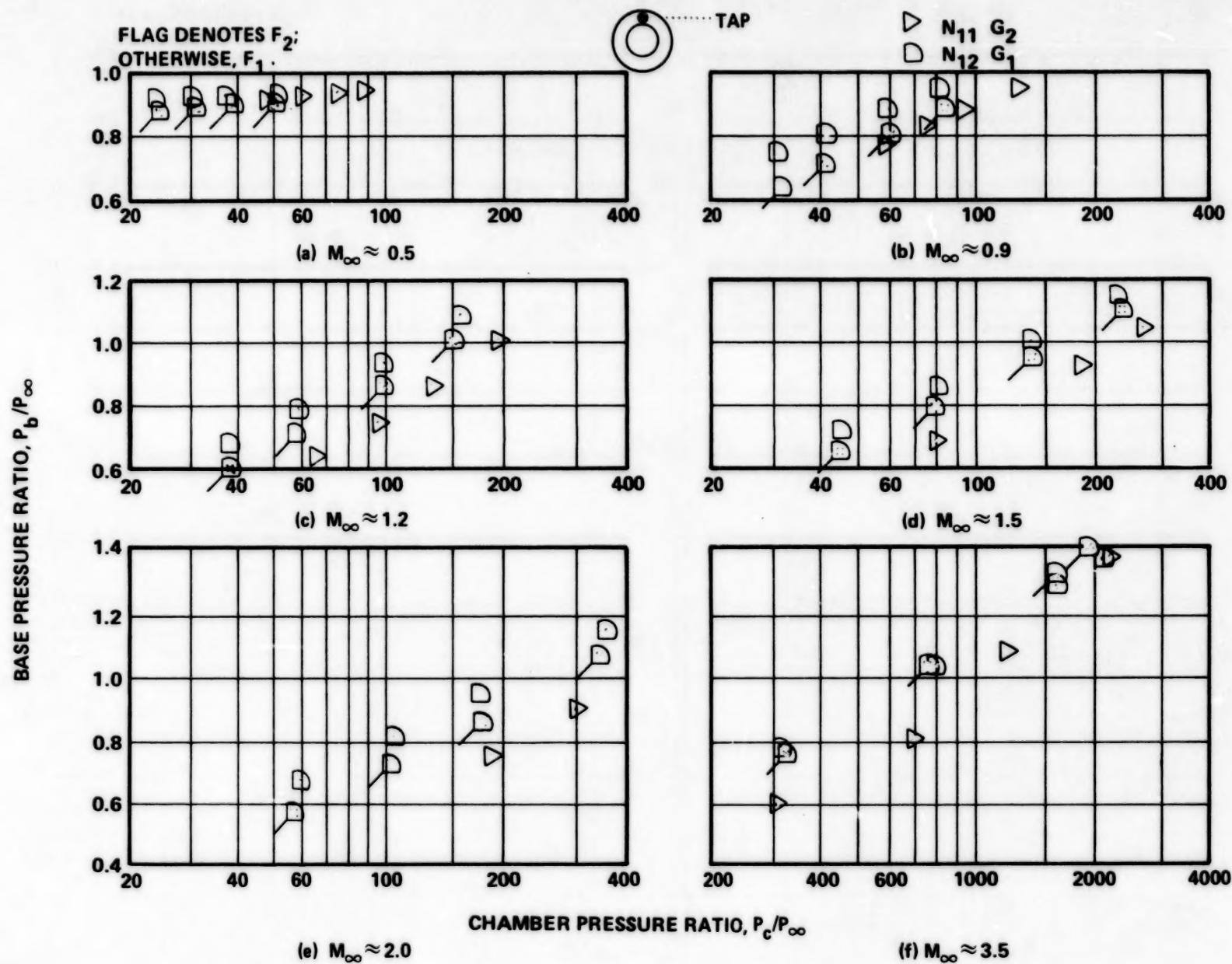


Figure 17. Base pressure trends for SRB-alone class ( $S_3F_1$ ,  $S_3F_2$ ).

## B. Plume Size

Base pressure is affected by plume flow in the base region, and the size of the plume is a first order parameter to be considered in performing simulation analyses. Furthermore, the initial plume angle ( $\delta_j$ ) is a good indicator of relative plume size. The range of plume sizes available in the data as a function of  $M_\infty$ , gas type, and configuration class is shown in Figure 18.

## C. Nozzle Performance

In such a plume simulation study, it is paramount that the performance of the nozzles be accurately known for use in data analysis. This fact was realized from the outset based on previous experience in testing small nozzles in the wind tunnel. Therefore, a concerted effort was maintained to provide information from which accurate nozzle performance could be determined. Procedures included conducting a complete mechanical inspection of the nozzle internal geometry, then calibrating each nozzle by flowing air at various  $P_c/P_{amb}$  levels into a quiescent evacuated chamber while measuring  $P_c$ ,  $T_c$ , nozzle internal wall pressures, and  $P_{amb}$ . Schlieren photos of the plumes were also recorded for reference purposes and comparisons with analytical predictions. Individual nozzle measurements are given in Section III and complete nozzle calibration data are included in Appendix C. An example of the nozzle wall pressure distributions is shown in Figure 19 for the air calibrations together with method of characteristics (MOC) computed distributions. Figure 20 shows an example of the effect of absolute  $P_c$  values on  $P_c/P_w$ . As can be seen, there are discrepancies between taps at the same station and a general trend with varying chamber pressure. The following procedure was developed for air nozzle plume computations from test run results and calibration data:

$$\frac{P_c}{P_{ex}} = mP_c + b + \Delta \left( \frac{P_c}{P_w} \right) \quad (1)$$

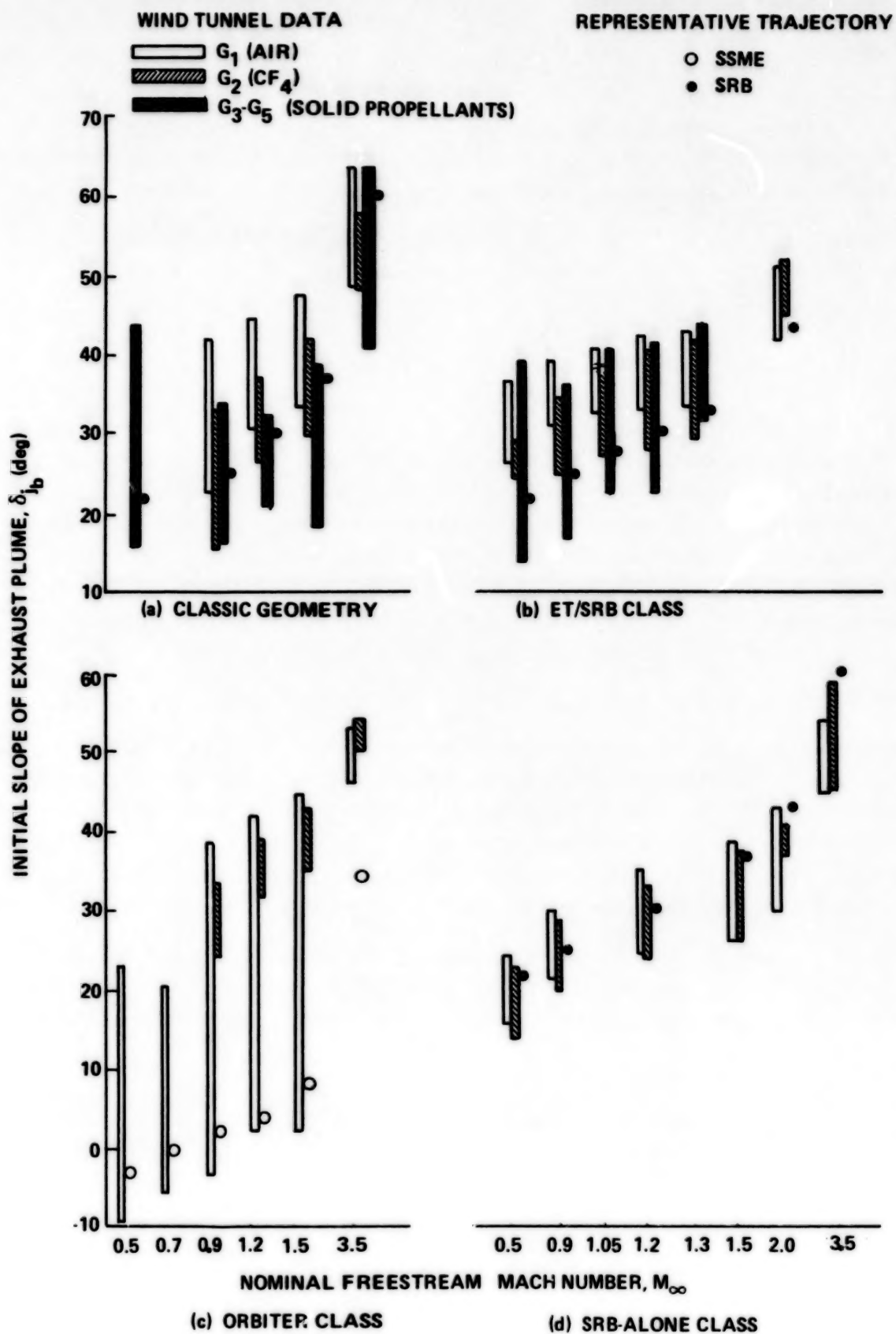


Figure 18. Range of plume sizes.

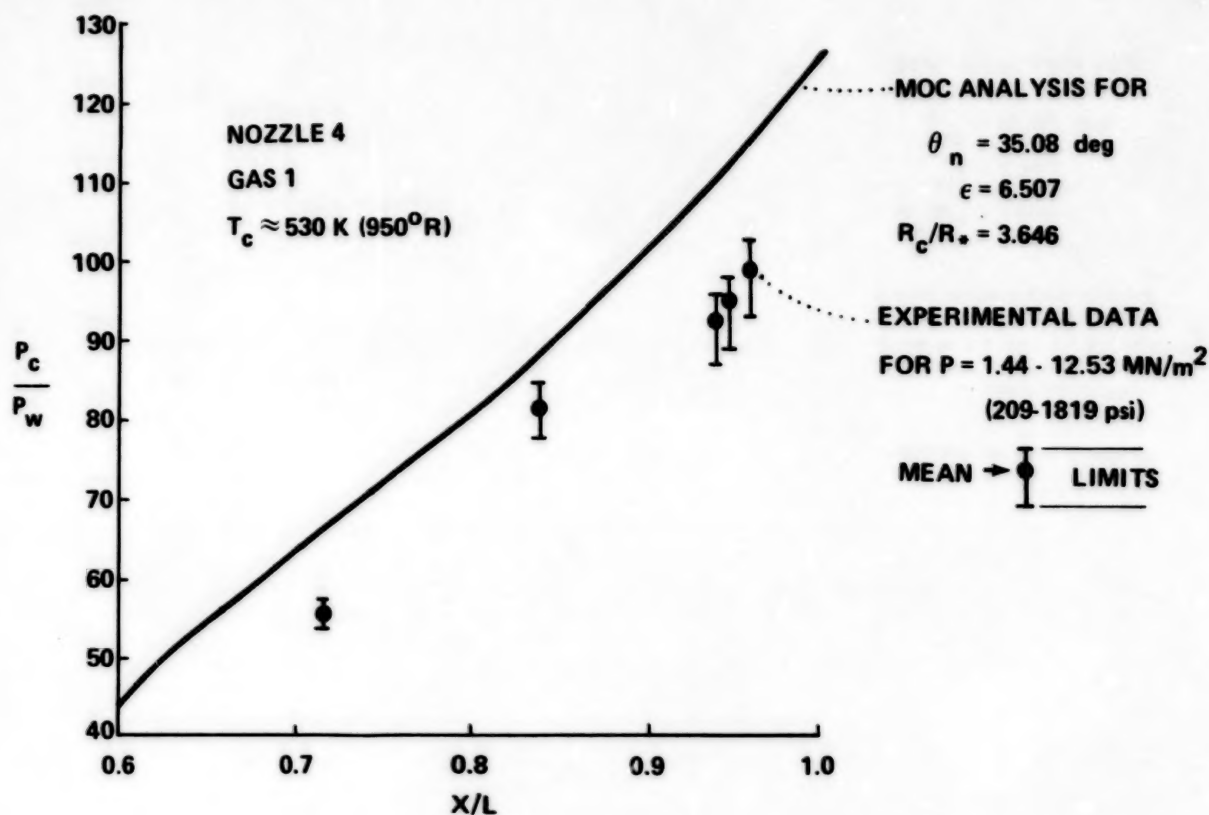


Figure 19. Example of wall pressure distribution from nozzle calibrations.

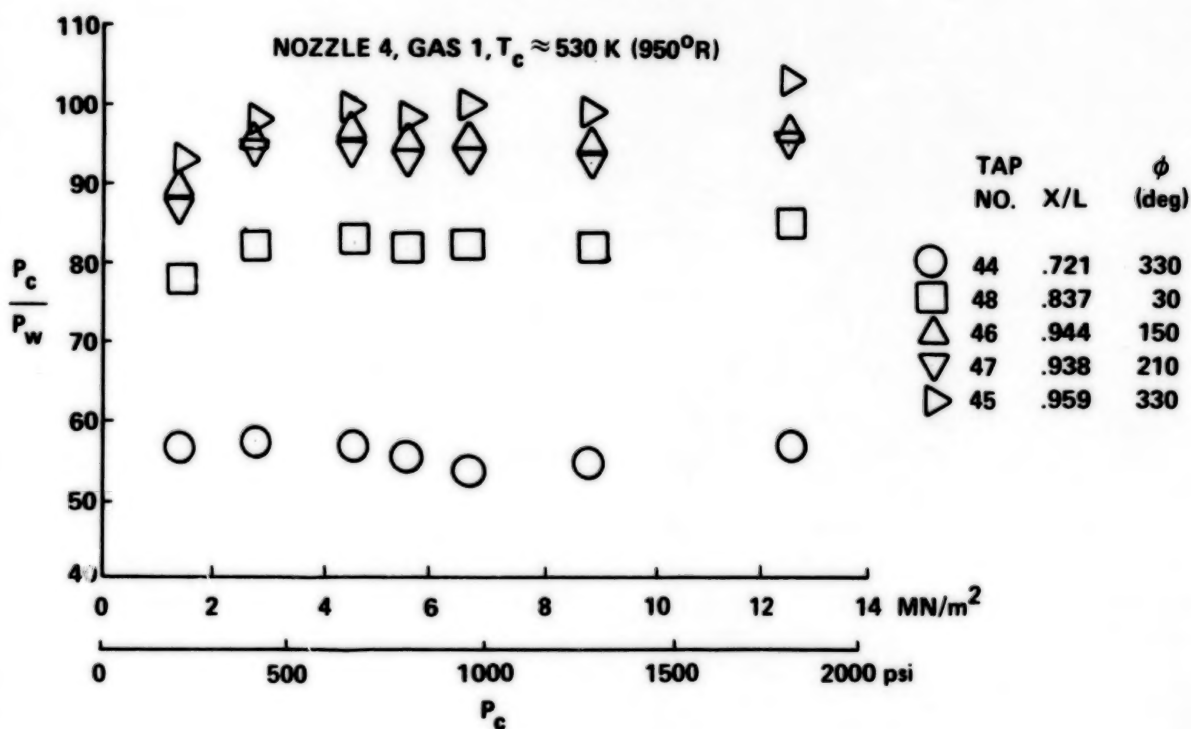
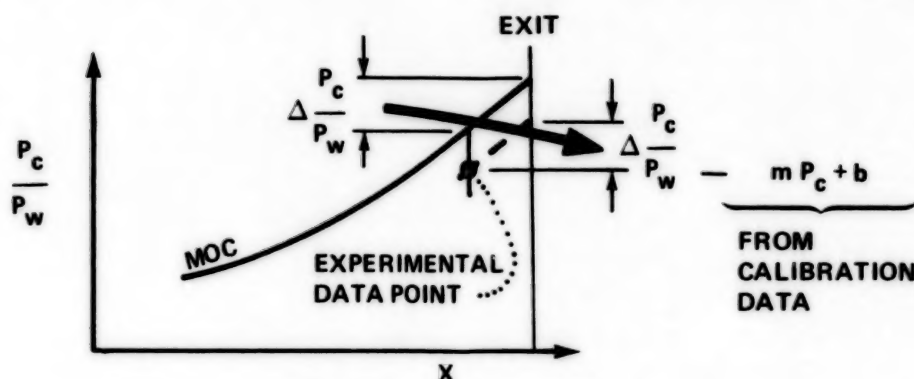


Figure 20. Effect of chamber pressure on wall pressure ratio.

where

$$\left. \begin{aligned} b &= \frac{P_c}{P_e} \text{ at } P_c \approx 0 \\ m &= \frac{P_c}{P_{ex}} \cdot \frac{1}{P_c}, \text{ gradient of } \frac{P_c}{P_{ex}} \text{ with absolute } P_c \end{aligned} \right\} \begin{array}{l} \text{from} \\ \text{experimental} \\ \text{data} \end{array} \quad (2)$$

$$\Delta \left( \frac{P_c}{P_w} \right) = \text{increment of } \frac{P_c}{P_w} \text{ from farthest downstream nozzle tap to the exit plane, as determined from the MOC nozzle solution}$$



Air nozzle performance was then determined from measured  $\theta_n$ , calibrated  $P_c/P_{ex}$ ,  $P_c/P_b$ , and  $\gamma_{ex}$ , using ideal gas MOC plume calculations. This method has been used in analysis of all air nozzle test data. However, for the  $CF_4$  and solid propellant data, real gas and two-phase (gas/solid) solutions are required. Using the equations of state of Reference 9 (which compare favorably with those of Reference 10) and the definition of  $\gamma = a^2/gPV$  for  $T_c < 444 \text{ K (800}^\circ\text{R)}$ , theoretical nozzle solutions have produced near identical results to the experimental data (Fig. 21). For  $CF_4$ , calculations were performed using the gas-only MOC computer code of Reference 11 with the  $CF_4$  properties of Reference 12. For the solid propellant plumes, calculations were performed using the two-phase MOC computer code of Reference 13.



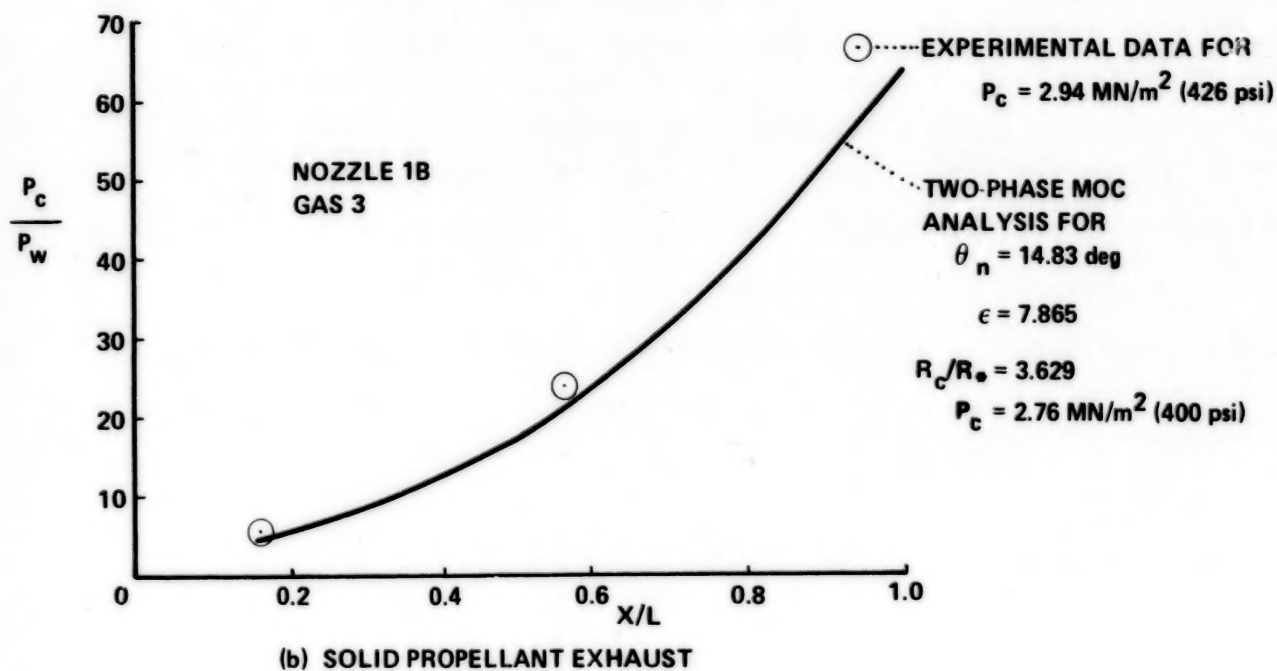
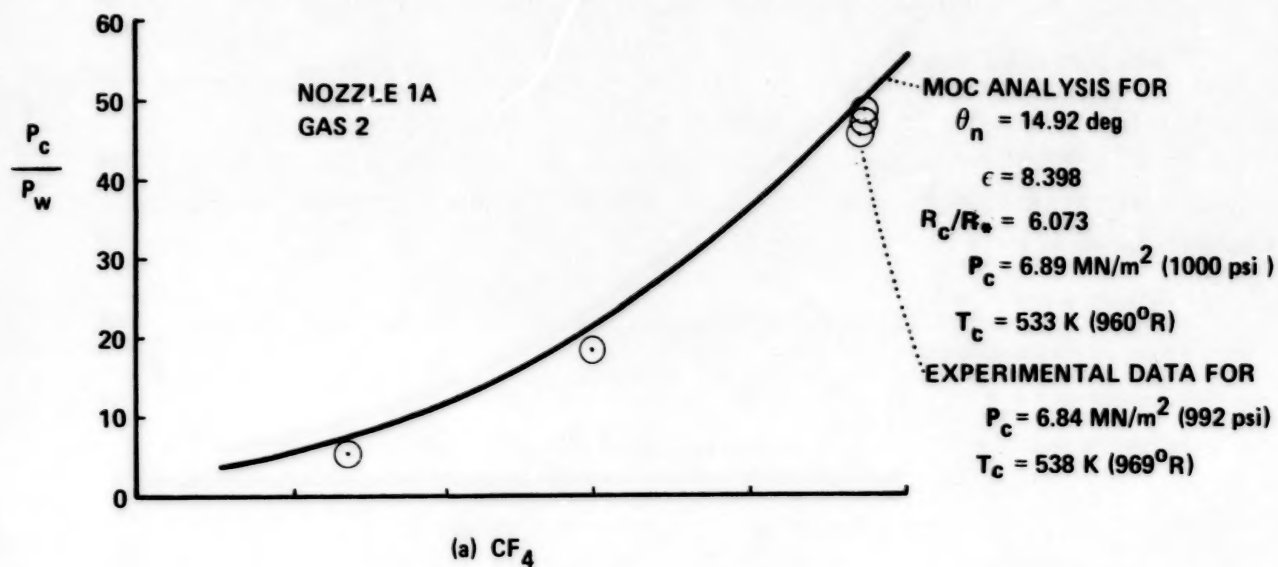


Figure 21. Comparison of analysis and experiment for nonair cases.

## D. Space Shuttle Base Pressure Simulation Procedure

A preliminary analysis of the present data has yielded a simulation technique that has been used for Space Shuttle development wind tunnel tests. Although these procedures are less than perfect, an outline is presented to provide insight into the development of the present "plume simulation" wind tunnel tests.

The simulation parameter used in the Space Shuttle development program is  $\left[ \delta_j \gamma_j^n \right]_{\text{MODEL}} = \left[ \delta_j \gamma_j^n \right]_{\text{PROTO}}$ , where  $n$  was determined empirically from correlation of gases and nozzle geometry for fixed-body configurations. However, this parameter does not allow explicit determination of base pressure ( $P_b$ ). Therefore, an implicit procedure was developed as follows. Figure 22 shows a typical simulation plot. The illustrated curve of possible prototype base pressure as a function of simulation parameter can be computed (knowing prototype engine characteristics) by use of a nozzle flow analysis (i.e., Reference 11 or 13) for a range of base pressures that might be expected. This curve is established for a given trajectory at a set of  $M_\infty$ ,  $P_\infty$ , and engine thrust level values. Next, a wind tunnel test is conducted at trajectory  $M_\infty$  while measurements are obtained at varying  $P_c$  levels ( $P_c$  directly varies  $\delta_j$  and correspondingly  $P_b$ ). The experimental  $P_c$  levels are chosen to cause  $\left[ \delta_j \gamma_j^n \right]_{\text{MODEL}}$  values to fall within the prototype range of interest. In the data

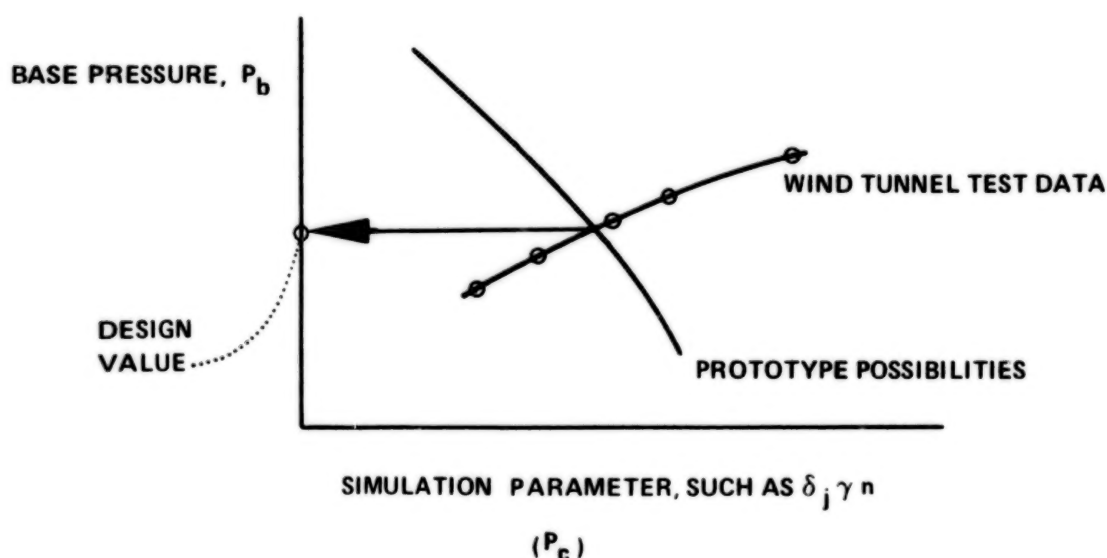


Figure 22. Basic simulation procedure.

analysis stage, the model  $P_b$  versus  $\left[ \delta_j \gamma_j^n \right]_{\text{MODEL}}$  is plotted on the same graph with the prototype possibility curve. The intersection of these two curves is the condition which simultaneously satisfies both prototype possibilities and model actualities, and thus  $\left[ \delta_j \gamma_j^n \right]_{\text{MODEL}} \equiv \left[ \delta_j \gamma_j^n \right]_{\text{PROTO}}$  for the given conditions. The previously described basic process is for a single-body configuration with either single or multiple nozzles. However, for the Space Shuttle with its multibody configuration, the process becomes more complicated, as the plumes of one body interact with the plume effect on an adjacent body. If mutual interaction exists between adjacent bases (e.g., between the SRB and Orbiter of the Space Shuttle), then tests must be conducted for a matrix of  $P_c / P_\infty$  for the two engine systems. Figure 23 illustrates the pair of "data/possibility" curve sets that are required for the mutual interaction problem. Points are successively chosen along each possibility curve until the values of simulation parameter "A" and "B" are matched. Then, at the two match points the design value of  $P_b$  for each body is produced.

From the previous discussion it can be seen possible to produce a simulation process which would be difficult to apply, in terms of data analysis or amounts of test time required to produce a design data point. It may be that other approaches to the simulation process could provide a better data match and/or simpler application processes, but that is beyond the scope of this report.

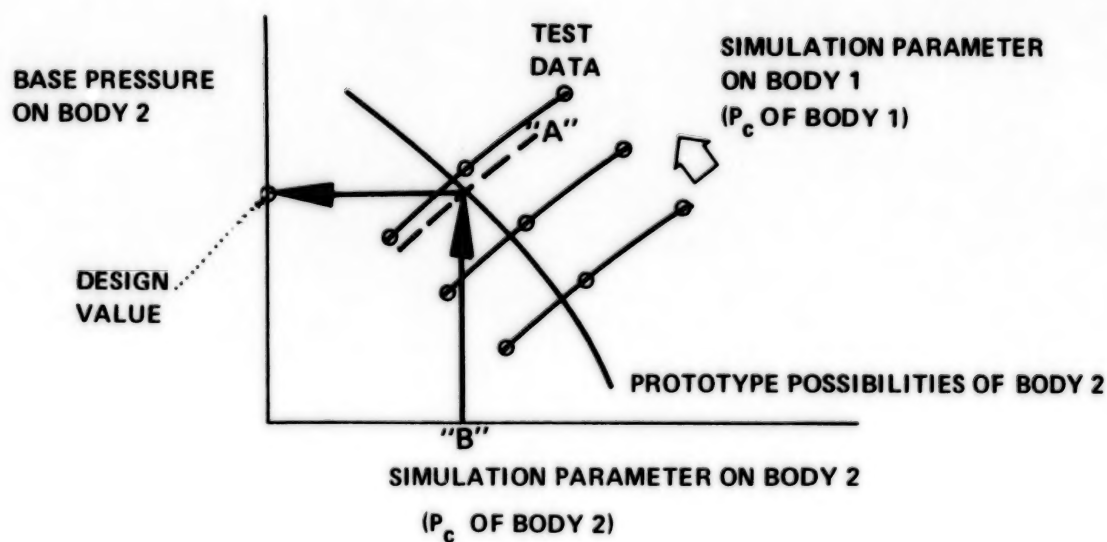
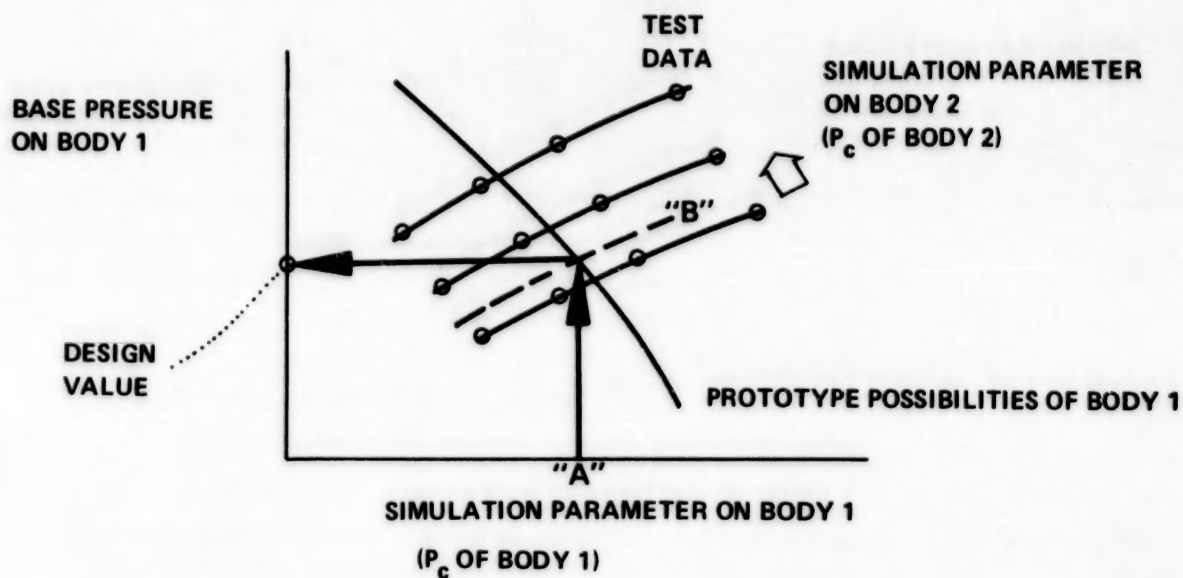


Figure 23. Multiple body simulation procedure.

## REFERENCES

1. Lott, R. A., Baker, L. R., Sims, W. H., and McCanna, R. W.: Power-on Base Pressure for Space Shuttle Launch Configurations. LMSC-HREC D225152, Lockheed Missiles and Space Company, 1971.
2. Goethert, B. H., and Barnes, L. T.: Some Studies of the Flow Pattern at the Base of Missiles with Rocket Exhaust Jets. AEDC-TR-58-12, Arnold Engineering Development Center, 1960.
3. Simon, Erwin H.: The George C. Marshall Space Flight Center's 14 x 14-Inch Trisonic Wind Tunnel Technical Handbook. NASA TM X-64624, 1971.
4. Pirello, C. J., Hardin, R. D., Heckart, M. V. and Brown, K. R.: An Inventory of Aeronautical Ground Research Facilities. Vol. I. Wind Tunnels. NASA CR-1874, 1971.
5. Anon.: Test Facilities Handbook. Arnold Engineering Development Center, 1974.
6. Baran, W. J.: Development of a Miniature Solid Propellant Rocket Motor for Use in Plume Simulation Studies. Report AA-4018-W-10, Calspan Corporation, 1974.
7. Hair, Leroy M.: Test Data Report for Solid Propellant Plume Aerodynamics Test Program in MSFC 14 x 14 Inch Trisonic Wind Tunnel. RTR 016-1, REMTECH, Inc., 1974.
8. Hendershot, K. C., Drzewiecki, R. F., and Lemoine, P. L.: Development of a Hot Rocket Subscale Space Shuttle Model for Base Flow Studies. AIAA Paper 74-1147, October 1974.
9. Jones, Robert A., and Hunt, James L. (With Appendix A by James L. Hunt, Kathryn A. Smith, and Robert B. Reynolds, and Appendix B by James L. Hunt and Lillian R. Boney): Use of Tetrafluoromethane to Simulate Real-Gas Effects on the Hypersonic Aerodynamics of Blunt Vehicles. NASA TR R-312, 1969.



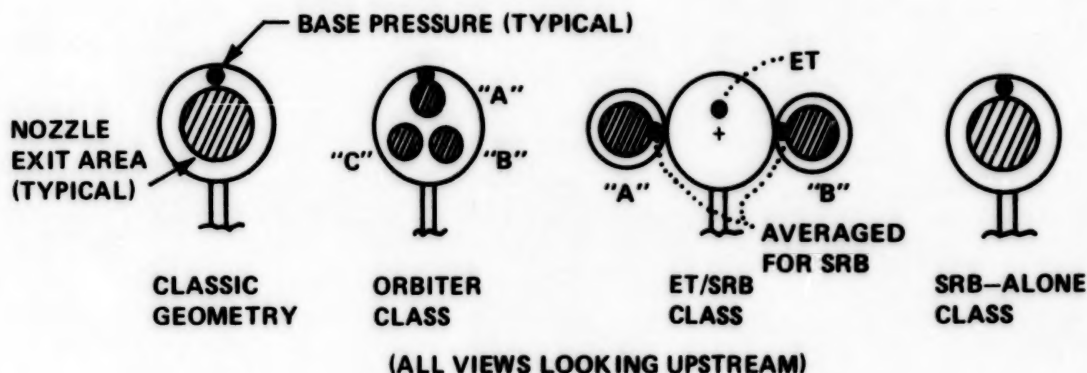
## REFERENCES (Concluded)

10. Talcott, Noel A., Jr.: Thermodynamic Properties of Gaseous Fluorocarbons and Isentropic Equilibrium Expansion of Two Binary Mixtures of Fluorocarbons and Argon. NASA TN D-8405, 1977.
11. Prozan, R. J.: Solution of Non-Isoenergetic Supersonic Flows by Method of Characteristics. LMSC-HREC D162220, Lockheed Missiles and Space Company, 1971.
12. Tevepaugh, J. A., Penny, M. M., and Baker, L. R.: Input Guide for Computer Program to Generate Thermodynamic Data for Air and Freon ( $\text{CF}_4$ ). LMSC-HREC TM D390169, Lockheed Missiles and Space Company, 1974.
13. Penny, M. M., Smith, S. D., Anderson, P. G., Sulyma, P. R., and Pearson, M. L.: Supersonic Flow of Chemically Reacting Gas Particle Mixtures. Vol. II. RAMP, A Computer Code for Analysis of Chemically Reacting Gas-Particle Flows. LMSC-HREC TR D496555-II, Lockheed Missiles and Space Company, 1976.

## APPENDIX A

### DATA OF PRIMARY INTEREST

The specific values of model chamber conditions, tunnel freestream parameters, and the basic (single) base pressure data for each valid wind-on run of the seven selected tests are presented in this appendix. The location on the various models of these pressures is shown in the following sketch:



Exact locations of the base pressure taps are shown in Table 6 of text. For the Orbiter class, the three nozzles were denoted "A", "B", and "C". The top nozzle was denoted "A", with "B" and "C" proceeding clockwise as viewed looking upstream. For the ET/SRB class in Test 7, nozzles denoted "A" were mounted on the left-hand side and nozzles denoted "B" on the right-hand side. In Test 8, the identity of which nozzle had been mounted on which side was not resolved. Data are given in Tables A-1 through A-4 for the four geometry types sketched. Within each table, data are grouped first by test number, then by gas and nozzle number. For each group, a subtitle is provided which includes nozzle design values of  $A/A_*$  and  $\theta_n$ ; exact values of nozzle geometry are shown in Table 3 of text. Beneath each subtitle the data are grouped by nominal Mach number. Within a Mach number group, data are presented in order of increasing  $P_c/P_\infty$ . Jet-off runs are presented first where available. These tabulated data are plotted in Figures 13 through 17 of text.

The complete sets of base, body, and nozzle pressures for each run are presented in Appendix B. The sequence of presentation of runs in Appendix B is identical to that of this appendix. An example is given of obtaining these

data for a particular case: Run 356/0 of Test 1. This case is the second one presented in this appendix within the classic geometry type (see Table A-I). Thus, the desired base and body data will be found at the second case in the classic geometry portion of the base and body section of Appendix B (Table B-1). At that location the following values of  $P_b/P_\infty$  are found:

TABLE B-1. - BASE AND BODY SURFACE PRESSURE RATIOS (F  
(A) E1A1

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$
		TEST 1, RUN 372/0			TEST 1, RUN 356/0			TEST 1, RUN 356/0	
0	.52	.915	.898		.850	.854		.845	.84
0	.64	.945	.944	.902	.846	.847	.856	.841	.84
.03	1.0	.935	.919	.935	.892	.875	.906	.891	.87
.22	1.0	.942	.963		.900	.949		.900	.942
.40	1.0	.976	.978		.968	.966		.966	.968
.58	1.0	.980	.979		.973	.973		.973	.975
.76	1.0	.979	.986	1.015	.976	.982	1.013	.977	.989
.94	1.0	1.013	.999		1.011	.992		1.013	.99
1.12	1.0	.976	.992	1.022	.978	.992	1.019	.976	.99
1.30	1.0	.963	.989		.966	.991		.963	.99
1.48	1.0	.973	.972		.972	.972		.970	.97
1.64	1.0	.968			.970			.967	
2.20	1.0	.962	.948	1.042	.968	.956	1.044	.963	.945
2.56	1.0	.956			.961			.955	
2.92	1.0	.963	.963		.971	.969		.964	.96
3.28	1.0	.979			.960			.977	

Correspondingly, the desired nozzle wall pressure data will be found in the classic geometry portion of the nozzle section of Appendix B (Table B-5). Because jet-off runs are not included in the nozzle section, the desired nozzle data will be found at the  $i$ th position:  $i = j - n_{\text{off}}$ , where the Appendix A case is at the  $j$ th position and  $n_{\text{off}}$  is the number of jet-off runs up to position  $j$ . In this example,  $j = 2$  and  $n_{\text{off}} = 1$  so  $i = 1$ . At that location, the value of  $P_c/P_\infty$  for Tap No. 47 is found to be 26.45.

TABLE A-1. TEST DATA OF PRIMARY INTEREST — CLASSIC GEOMETRY

ID.	FREESTREAM				CHAMBER		BASE		
RUN/ RERUN	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P
	(PSFA)	(OR)	(M/FT)		(PSIA)	(OR)			
TEST 1	---		G1,N3		(AIR, A/A=3.5, 25 DEG.)				
372/0	.889	1553	563	5.0	0	0	.948	0	0
356/0	.888	1553	563	5.0	466	958	.846	51	43
323/0	.903	1528	562	5.1	472	518	.841	53	44
357/0	.901	1531	564	5.0	837	966	.933	84	79
354/0	.906	1524	561	5.1	865	702	.939	87	82
322/0	.908	1520	562	5.1	952	510	.967	93	90
353/0	.905	1525	561	5.1	1217	708	.994	116	115
358/0	.901	1532	562	5.1	1234	989	.995	117	116
321/0	.910	1516	563	5.1	1422	510	1.047	129	135
359/0	.902	1530	562	5.1	1501	983	1.029	137	141
352/0	.907	1523	561	5.1	1584	712	1.037	144	150
320/0	.909	1517	563	5.1	1746	504	1.087	152	166
373/0	1.194	1078	562	5.4	0	0	.913	0	0
363/0	1.194	1078	563	5.4	451	950	.709	85	60
316/0	1.208	1059	563	5.4	519	571	.741	95	71
362/0	1.194	1078	562	5.4	854	984	.864	132	114
349/0	1.206	1062	561	5.4	856	704	.873	133	116
317/0	1.206	1061	563	5.4	1054	511	.967	148	143
350/0	1.203	1066	561	5.4	1211	711	.979	167	164
329/0	1.189	1086	562	5.4	1251	883	.993	167	166
361/0	1.211	1055	562	5.4	1224	1004	.994	168	167
328/0	1.186	1089	562	5.4	1502	890	1.057	188	199
318/0	1.207	1060	563	5.4	1545	507	1.138	184	210
351/0	1.203	1066	562	5.4	1616	708	1.074	203	218
360/0	1.208	1058	561	5.4	1619	1021	1.092	202	220
319/0	1.207	1060	562	5.4	1808	508	1.207	204	246
374/0	1.459	749	564	5.2	0	0	.962	0	0
347/0	1.459	750	563	5.2	461	737	.766	116	59
364/0	1.468	741	566	5.2	460	931	.770	116	89
315/0	1.459	749	563	5.2	510	512	.801	122	98
365/0	1.484	723	566	5.2	847	961	.924	182	169
346/0	1.479	728	561	5.2	857	730	.919	184	170
314/0	1.477	731	563	5.2	983	510	.985	197	194
345/0	1.482	725	560	5.3	1202	717	1.012	236	239

TABLE A-1. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P (PSFA)	TT (°R)	RE/L (M/FT)	PC (PSIA)	TC (°R)	PB/P	PC/PB	PC/P
366/0	1.491	717	565	5.2	1244	990	1.035	241	250
313/0	1.476	732	563	5.2	1431	512	1.131	249	282
344/0	1.478	729	560	5.3	1593	710	1.088	289	315
367/0	1.487	720	567	5.2	1595	993	1.104	289	319
312/0	1.478	730	563	5.2	1702	508	1.216	276	336
375/0	3.479	175	572	10.0	0	0	.981	0	0
376/0	3.480	175	563	10.3	429	943	.674	524	353
340/0	3.480	175	563	10.3	431	675	.665	534	355
308/1	3.480	175	563	10.3	513	727	.985	429	423
370/0	3.480	175	565	10.2	850	966	.836	838	700
341/0	3.480	175	563	10.3	864	686	.863	824	711
379/0	3.480	175	563	10.3	864	861	.833	854	712
337/0	3.480	175	569	10.1	990	545	.992	822	815
309/0	3.480	175	565	10.2	1087	502	1.090	821	895
342/0	3.480	175	563	10.3	1134	688	.970	963	934
380/0	3.480	175	563	10.3	1220	859	.963	1042	1004
310/0	3.480	175	564	10.2	1443	547	1.166	1019	1188
343/0	3.480	175	563	10.3	1504	700	1.094	1132	1238
381/0	3.480	175	563	10.3	1509	844	1.022	1216	1243
311/0	3.480	175	565	10.2	1544	555	1.212	1050	1272
377/2	3.480	175	568	10.1	1555	1002	1.022	1253	1280
336/0	3.480	175	569	10.1	1558	577	1.356	946	1283
TEST 1 --- G1, N4 (AIR, A/A=6.5, 35 DEC.)									
215/0	.905	1525	560	5.1	0	0	.940	0	0
155/0	.893	1545	561	5.1	374	808	.776	45	35
154/0	.896	1540	560	5.1	380	745	.775	46	36
195/0	.897	1537	562	5.1	394	992	.767	48	37
194/0	.900	1533	560	5.1	407	877	.768	50	38
115/0	.901	1531	561	5.1	411	660	.775	50	39
193/0	.892	1546	560	5.1	747	901	.822	85	70
156/0	.889	1549	561	5.0	750	836	.827	84	70
196/0	.907	1523	562	5.1	766	1020	.820	88	72
116/0	.911	1515	561	5.1	753	702	.821	87	72
153/0	.891	1548	560	5.1	851	760	.842	94	79
152/0	.894	1543	561	5.1	1087	757	.889	114	101



TABLE A-1. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P
		(PSFA)	(°R)	(M/FT)	(PSIA)	(°R)			
117/0	.899	1534	561	5.1	1123	686	.885	119	105
197/0	.899	1535	562	5.1	1128	1032	.887	119	106
157/0	.887	1555	560	5.0	1153	848	.892	120	107
192/0	.902	1530	560	5.1	1162	922	.886	124	109
198/0	.905	1524	562	5.1	1413	1041	.928	144	134
151/0	.899	1535	561	5.1	1426	760	.928	144	134
118/0	.893	1544	560	5.1	1484	684	.934	148	138
191/0	.902	1530	561	5.1	1477	926	.929	150	139
158/0	.894	1542	561	5.1	1518	856	.940	151	142
150/0	.901	1529	561	5.1	1741	763	.962	170	164
190/0	.898	1537	560	5.1	1839	943	.968	178	172
159/0	.899	1535	561	5.1	1836	856	.971	177	172
119/0	.905	1525	567	5.0	1826	666	.981	176	172
199/0	.906	1523	562	5.1	1842	1050	.973	179	174
216/0	1.199	1070	560	5.4	0	0	.744	0	0
145/0	1.201	1067	560	5.4	377	737	.558	91	51
164/0	1.199	1071	562	5.4	383	824	.564	91	51
204/0	1.195	1076	562	5.4	386	993	.558	92	52
124/0	1.198	1071	567	5.3	387	672	.571	91	52
185/0	1.196	1075	560	5.4	392	877	.570	92	53
123/0	1.204	1063	567	5.3	762	676	.712	145	103
203/0	1.198	1073	562	5.4	788	1022	.705	150	106
163/0	1.200	1069	562	5.4	796	841	.716	150	107
146/0	1.200	1070	559	5.4	800	756	.712	151	108
186/0	1.203	1065	560	5.4	801	905	.717	151	108
162/0	1.195	1076	562	5.4	1087	843	.787	185	145
147/0	1.206	1060	559	5.4	1113	758	.792	191	151
122/0	1.205	1063	567	5.3	1126	675	.806	189	152
202/0	1.200	1070	562	5.4	1144	1035	.799	193	154
187/0	1.207	1060	559	5.4	1144	918	.805	193	155
161/0	1.193	1079	562	5.4	1430	849	.867	220	191
201/0	1.201	1069	561	5.4	1457	1031	.862	228	196
148/0	1.200	1069	559	5.4	1457	764	.864	227	196
121/0	1.204	1063	567	5.3	1467	670	.882	225	199
188/0	1.207	1060	559	5.4	1485	907	.876	230	202

TABLE A-1. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P (PSFA)	TT (OR)	RE/L (M/FT)	PC (PSIA)	TC (OR)	PE/P	PC/PB	PC/P
120/0	1.198	1072	567	5.3	1814	667	.952	256	244
149/0	1.195	1076	559	5.4	1827	770	.933	262	245
200/0	1.198	1073	562	5.4	1832	1034	.937	262	246
160/0	1.193	1079	562	5.4	1841	855	.940	261	246
189/0	1.201	1067	559	5.4	1864	934	.948	265	252
205/0	1.437	774	563	5.3	335	991	.576	108	62
165/0	1.462	746	562	5.2	407	835	.633	124	79
125/0	1.467	741	561	5.3	458	707	.653	136	89
206/0	1.471	737	564	5.2	754	1016	.754	195	147
166/0	1.461	747	562	5.2	763	847	.769	191	147
126/0	1.470	738	561	5.3	820	706	.778	206	160
207/0	1.445	764	562	5.3	1081	1045	.820	249	204
167/0	1.476	732	562	5.2	1144	852	.866	260	225
127/0	1.481	726	562	5.2	1177	685	.867	269	233
208/0	1.455	754	563	5.2	1492	1047	.907	314	285
168/0	1.482	725	563	5.2	1559	861	.948	326	310
128/0	1.482	725	561	5.2	1580	696	.953	329	314
209/0	1.456	752	563	5.2	1868	1058	.968	369	358
129/0	1.488	719	562	5.2	1825	711	.995	368	366
169/0	1.487	720	563	5.2	1858	870	1.000	372	372
218/0	3.480	175	560	10.4	0	0	.182	0	0
134/0	3.480	175	565	10.2	381	704	.558	562	313
210/0	3.480	175	561	10.3	430	995	.585	606	354
133/0	3.480	175	571	10.1	773	737	.718	886	636
211/0	3.480	175	561	10.3	804	1023	.725	913	662
132/0	3.480	175	565	10.2	1157	702	.822	1157	951
212/2	3.480	175	562	10.3	1159	1050	.869	1098	954
131/0	3.480	175	571	10.1	1479	724	.907	1341	1216
213/0	3.480	175	561	10.3	1522	1020	.911	1377	1254
214/0	3.480	175	561	10.3	1831	1019	.967	1560	1508
130/0	3.480	175	565	10.2	1851	730	.990	1540	1525
TEST 1	---				G1,N5	(AIR, A/A=3.5, 35 DEG.)			
709/0	3.480	175	570	10.1	435	817	.939	382	358
702/0	3.480	175	569	10.1	441	738	.928	392	364
712/0	3.480	175	563	10.3	532	543	.984	445	438

TABLE A-1. (Continued)

ID.	FREESTREAM				CHAMBER		BASE		
RUN/ RERUN	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P
	(PSFA)	(OR)	(M/FT)		(PSIA)	(OR)			
708/0	3.480	175	570	10.1	728	841	1.145	524	600
710/0	3.480	175	561	10.3	857	985	1.363	518	706
703/0	3.480	175	568	10.1	863	734	1.204	590	711
701/0	3.480	175	563	10.3	973	511	1.361	589	801
704/0	3.480	175	568	10.2	1243	691	1.401	730	1023
715/0	3.480	175	561	10.3	1248	997	1.569	655	1028
707/0	3.480	175	570	10.1	1258	854	1.417	731	1036
713/0	3.480	175	562	10.3	1373	502	1.673	675	1128
714/0	3.480	175	563	10.3	1445	523	1.717	693	1189
706/0	3.480	175	569	10.1	1558	865	1.670	768	1283
711/0	3.480	175	562	10.3	1567	989	1.765	731	1291
705/0	3.480	175	568	10.1	1587	695	1.554	840	1306
TEST 1 --- G2,N1A (CF4, A/A=8.0, 15 DEG.)									
551/0	.898	1536	557	5.1	0	0	.937	0	0
542/0	.899	1535	559	5.1	481	673	.823	55	45
541/0	.894	1544	559	5.1	854	861	.827	96	80
519/0	.904	1526	557	5.1	1120	775	.857	123	106
540/0	.904	1526	560	5.1	1189	867	.867	129	112
550/0	.893	1543	561	5.1	1224	1002	.887	129	114
518/0	.909	1518	558	5.1	1221	695	.864	134	116
539/0	.906	1523	560	5.1	1569	884	.913	162	148
538/0	.901	1530	560	5.1	1877	886	.944	187	177
552/0	1.195	1076	561	5.4	0	0	.753	0	0
533/0	1.195	1077	560	5.4	510	845	.568	120	68
534/0	1.202	1066	559	5.4	855	862	.667	173	115
535/0	1.204	1063	559	5.4	866	865	.671	175	117
520/0	1.204	1063	557	5.4	1134	770	.722	213	154
517/0	1.213	1050	558	5.4	1216	693	.725	230	167
549/0	1.204	1064	561	5.4	1242	997	.772	218	168
536/0	1.198	1072	560	5.4	1566	888	.807	261	210
537/0	1.202	1065	560	5.4	1931	890	.868	301	261
553/0	1.456	751	557	5.3	0	0	.710	0	0
532/0	1.444	766	561	5.3	496	810	.600	155	93
531/0	1.459	749	561	5.3	851	860	.718	228	164
516/0	1.468	739	558	5.3	1123	700	.753	290	219

TABLE A-1. (Continued)

ID.	FREESTREAM				CHAMBER		BASE		
RUN/ RERUN	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P
	(PSFA)	(°R)	(M/FT)		(PSIA)	(°R)			
521/0	1.468	739	558	5.3	1145	768	.769	290	223
530/0	1.467	740	561	5.2	1146	866	.788	283	223
548/0	1.473	733	560	5.3	1255	1003	.829	297	246
529/0	1.482	725	561	5.2	1550	877	.869	355	308
528/0	1.484	722	561	5.2	1850	877	.919	401	369
554/0	3.480	175	561	10.3	0	0	.262	0	0
523/1	3.480	175	559	10.4	418	815	.478	720	344
524/0	3.480	175	559	10.4	794	913	.640	1022	654
522/0	3.480	175	559	10.4	1151	754	.677	1401	948
515/0	3.480	175	559	10.4	1165	703	.661	1449	958
546/0	3.480	175	559	10.4	1190	907	.747	1313	980
547/0	3.480	175	562	10.3	1217	1026	.792	1265	1003
525/0	3.480	175	559	10.4	1239	841	.728	1401	1020
526/0	3.480	175	559	10.4	1555	844	.810	1582	1281
527/0	3.480	175	559	10.4	1817	833	.851	1758	1496
TEST 2 --- G3,N1C ( 2%, A/L=8.0, 15 DEG.)									
32/0	1.450	1189	551	8.5	416	5229	.511	99	50
133/0	1.430	1205	549	8.4	868	5229	.624	166	104
33/0	1.430	1209	551	8.4	911	5229	.648	167	109
35/0	1.430	1217	548	8.5	1886	5229	.763	293	223
34/0	1.440	1201	550	8.5	1860	5229	.764	292	223
49/0	3.480	194	551	11.8	0	0	.282	0	0
49/1	3.480	194	561	11.5	0	0	.313	0	0
49/2	3.480	194	561	11.5	0	0	.281	0	0
50/0	3.479	49	549	3.0	0	0	.435	0	0
136/0	3.480	194	548	11.9	417	5229	.505	612	309
137/0	3.480	194	548	11.9	1146	5229	.708	1199	849
138/0	3.480	194	548	11.9	1850	5229	.812	1688	1370
237/0	3.480	49	548	3.0	1226	5229	1.536	2370	3640
238/0	3.480	49	543	3.0	1363	5229	1.626	2479	4030
TEST 6 --- G3,N1D ( 2%, A/L=8.0, 15 DEG.)									
8	.500	429	550	.7	0	0	.987	0	0
8	.500	428	550	.7	483	5229	.968	168	163
21	.898	430	555	1.4	0	0	.927	0	0
21	.900	430	555	1.4	484	5229	.918	177	162

TABLE A-1. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P (PSFA)	TT (°R)	RE/L (M/FT)	PC (PSIA)	TC (°R)	PB/P	PC/PB	PC/P
TEST 6	---	G3,N1E (2%, A/A=8.0, 15 DEG.)							
5	.499	863	554	1.4	0	0	.980	0	0
5	.500	863	554	1.4	463	5229	.952	81	77
18	.898	862	561	2.8	0	0	.922	0	0
18	.900	862	561	2.9	431	5229	.847	85	72
15/2	1.200	857	578	4.2	0	0	.807	0	0
15	1.200	857	578	4.2	442	5229	.642	116	74
TEST 2	---	G3,N2A (2%, A/A=4.0, 15 DEG.)							
47/0	1.460	1164	543	8.5	0	0	.737	0	0
47/1	1.466	1153	542	8.6	0	0	.705	0	0
47/2	1.460	1164	541	8.6	0	0	.728	0	0
72/0	1.430	1217	556	8.3	403	5229	.619	77	48
48/0	3.480	194	560	11.5	0	0	.364	0	0
48/1	3.480	194	559	11.5	0	0	.341	0	0
48/2	3.480	194	559	11.5	0	0	.318	0	0
161/0	3.480	194	562	11.5	407	5229	.783	385	301
261/0	3.479	49	547	3.0	421	5229	1.523	812	1237
TEST 6	---	G3,N2B (2%, A/A=4.0, 15 DEG.)							
11	.500	2257	564	3.6	0	0	.976	0	0
11	.500	2259	564	3.6	544	5229	.949	37	35
TEST 2	---	G4,N1B (16%, A/A=8.0, 15 DEG.)							
27/0	1.430	1215	556	8.3	397	6203	.515	91	47
28/0	1.420	1236	559	8.3	821	6203	.609	157	96
29/0	1.400	1272	548	8.6	1411	6203	.696	229	160
41/2	3.480	194	557	11.6	0	0	.201	0	0
1/1	3.480	194	564	11.4	349	6203	.597	433	259
2/0	3.480	194	561	11.5	791	6203	.824	711	586
3/0	3.480	194	563	11.4	1331	6203	1.005	981	986
4/2	3.480	194	558	11.6	1849	6203	1.032	1327	1370
TEST 6	---	G4,N1D (16%, A/A=8.0, 15 DEG.)							
24	.500	859	550	1.4	0	0	.979	0	0
24	.500	858	550	1.4	363	6203	.945	64	61
37	.500	429	554	.7	295	6203	.967	102	99
43	.903	576	554	1.9	0	0	.919	0	0
43	.900	576	554	1.9	351	6203	.857	102	88



TABLE A-1. (Concluded)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P (PSFA)	TT (°R)	RE/L (M/FT)	PC (PSIA)	TC (°R)	PB/P	PC/PB	PC/P
56	1.201	858	577	4.2	0	0	.807	0	0
56	1.200	858	577	4.2	373	6203	.626	100	63
TEST 6 --- G4,N1E (16%, A/A=8.0, 15 DEG.)									
27/2	.500	574	551	.9	0	0	.983	0	0
27	.500	574	551	.9	351	6203	.956	92	88
34	.897	859	558	2.9	0	0	.922	0	0
34	.900	859	558	2.9	308	6203	.845	61	52
62	.900	426	553	1.4	596	6203	.980	206	201
50	1.200	587	561	3.0	0	0	.814	0	0
50	1.200	587	561	3.0	343	6203	.680	124	84
TEST 2 --- G4,N2A (16%, A/A=4.0, 15 DEG.)									
47/0	1.460	1164	543	8.5	0	0	.737	0	0
47/1	1.466	1153	542	8.6	0	0	.705	0	0
47/2	1.460	1164	541	8.6	0	0	.728	0	0
70/0	1.410	1242	557	8.3	474	6203	.699	79	55
71/0	1.380	1301	555	8.4	855	6203	.811	117	95
48/0	3.480	194	560	11.5	0	0	.364	0	0
48/1	3.480	194	559	11.5	0	0	.341	0	0
48/2	3.480	194	559	11.5	0	0	.318	0	0
62/2	3.480	194	556	11.6	466	6203	1.007	343	345
163/0	3.480	194	561	11.5	878	6203	1.187	548	650
TEST 6 --- G4,N2B (16%, A/A=4.0, 15 DEG.)									
31	.498	2264	567	3.6	0	0	.976	0	0
31	.500	2264	567	3.6	402	6203	.948	27	26
66	.500	2254	564	3.6	470	6203	.961	31	30
40	.500	424	551	.7	544	6203	1.024	181	185
47	.898	1764	574	5.7	0	0	.909	0	0
47	.900	1764	574	5.7	425	6203	.904	38	35
53	1.200	1111	589	5.3	0	0	.802	0	0
53	1.200	1111	589	5.3	433	6203	.782	72	56

TABLE A-2. TEST DATA OF PRIMARY INTEREST — ORBITER CLASS

ID.	FREESTREAM				CHAMBER		BASE		
RUN/ RERUN	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P
	(PSFA)	(OR)	(M/FT)		(PSIA)	(OR)			
TEST 3 (EDGE TAP) -- G1,N31 (AIR, A/A=5.3, CONTOURED)									
220/0	.500	2186	560	3.5	0	0	.980	0	0
215/0	.505	2178	560	3.6	256	911	.931	18	17
210/0	.498	2188	560	3.5	480	895	.932	34	32
209/0	.500	2185	560	3.5	992	903	.918	71	65
204/0	.504	2182	560	3.6	1479	895	.920	106	98
219/0	.898	1536	560	5.1	0	0	.927	0	0
216/0	.904	1525	560	5.1	179	892	.833	20	17
223/0	.898	1538	560	5.1	216	912	.840	24	20
214/0	.899	1535	560	5.1	254	906	.835	29	24
211/0	.899	1534	560	5.1	495	897	.783	59	46
208/0	.895	1541	560	5.1	992	880	.783	118	93
205/0	.895	1541	560	5.1	1475	894	.825	167	138
218/0	1.205	1063	560	5.4	0	0	.750	0	0
217/0	1.198	1072	560	5.4	125	891	.574	29	17
224/0	1.204	1064	560	5.4	169	903	.523	44	23
213/1	1.201	1068	560	5.4	256	904	.415	83	34
212/0	1.197	1073	560	5.4	502	899	.487	138	67
222/0	1.202	1066	560	5.4	991	893	.596	225	134
221/0	1.201	1067	560	5.4	1499	896	.659	307	202
206/0	1.490	797	560	5.8	0	0	.713	0	0
195/0	1.515	768	560	5.8	88	657	.492	34	16
194/0	1.497	788	560	5.8	85	863	.526	30	16
207/0	1.488	799	560	5.8	105	836	.488	39	19
196/0	1.490	796	560	5.8	250	657	.387	117	45
199/0	1.494	792	544	6.0	257	887	.396	118	47
198/0	1.492	794	560	5.8	500	897	.513	177	91
197/0	1.496	789	560	5.8	513	667	.516	181	94
201/0	1.494	792	560	5.8	999	668	.619	293	182
200/0	1.504	780	560	5.8	987	921	.621	293	182
203/0	1.499	786	560	5.8	1499	917	.684	402	275
202/0	1.512	772	560	5.8	1495	650	.686	407	279
TEST 3 (EDGE TAP) -- G1,N32 (AIR, A/A=4.0, 10 DEG.)									
125/0	.501	2183	560	3.5	0	0	.978	0	0
121/0	.505	2180	560	3.6	248	909	.928	18	16

TABLE A-2. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P (PSFA)	TT (°R)	RE/L (M/FT)	PC (PSIA)	TC (°R)	PB/P	PC/PB	PC/P
114/0	.501	2182	560	3.5	255	664	.929	18	17
115/0	.499	2187	560	3.5	492	653	.912	36	32
120/0	.502	2184	560	3.5	493	911	.913	36	33
136/0	.500	2187	569	3.5	1000	673	.929	71	66
130/0	.502	2184	560	3.6	994	909	.930	70	66
137/0	.505	2181	560	3.6	1449	686	.938	102	96
131/0	.506	2180	575	3.5	1508	908	.938	106	100
126/0	.899	1534	560	5.1	0	0	.922	0	0
111/0	.900	1532	560	5.1	153	654	.848	17	14
124/0	.899	1537	560	5.1	175	892	.836	20	16
122/0	.904	1528	560	5.1	247	896	.819	28	23
112/0	.903	1527	560	5.1	254	664	.814	29	24
116/0	.906	1523	560	5.1	496	648	.770	61	47
119/0	.906	1523	560	5.1	493	917	.774	60	47
135/0	.900	1535	569	5.0	1003	644	.846	111	94
128/1	.896	1541	560	5.1	1022	896	.850	112	96
132/0	.900	1535	575	4.9	1490	905	.899	155	140
138/0	.900	1533	560	5.1	1496	666	.901	156	140
127/0	1.199	1072	560	5.4	0	0	.750	0	0
110/1	1.197	1073	560	5.4	120	659	.544	30	16
109/2	1.199	1071	560	5.4	125	891	.540	31	17
123/0	1.202	1067	560	5.4	245	906	.480	69	33
113/0	1.202	1066	560	5.4	254	664	.486	71	34
117/0	1.198	1072	560	5.4	497	662	.601	111	67
118/0	1.201	1069	560	5.4	496	915	.605	111	67
134/0	1.190	1084	569	5.3	998	678	.713	186	133
129/0	1.196	1075	560	5.4	993	909	.728	183	133
139/1	1.200	1071	560	5.4	1503	655	.791	256	202
133/0	1.205	1062	569	5.3	1497	915	.784	259	203
150/0	1.493	793	560	5.8	0	0	.709	0	0
148/0	1.498	788	560	5.8	84	669	.471	33	15
149/0	1.500	785	560	5.8	85	872	.450	35	16
146/0	1.494	792	560	5.8	250	663	.507	90	45
145/1	1.495	791	560	5.8	249	913	.509	89	45
144/1	1.493	793	560	5.8	494	913	.627	143	90

TABLE A-2. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P (PSFA)	TT (°R)	RE/L (M/FT)	PC (PSIA)	TC (°R)	PB/P	PC/PB	PC/P
147/0	1.494	792	560	5.8	500	666	.628	145	91
142/0	1.498	788	560	5.8	1001	912	.772	237	183
141/0	1.499	786	560	5.8	1023	668	.767	245	188
140/0	1.499	786	560	5.8	1502	652	.834	330	275
143/0	1.505	780	560	5.8	1500	901	.823	336	277
TEST 3 (EDGE TAP) -- G1,N33 (AIR, A/A=8.0, 15 DEG.)									
68/0	.503	2181	560	3.6	0	0	.980	0	0
67/0	.502	2182	560	3.6	238	810	.928	17	16
56/0	.498	2189	560	3.5	257	633	.933	18	17
62/0	.501	2185	560	3.5	488	872	.922	35	32
61/0	.499	2186	560	3.5	496	637	.914	36	33
76/0	.499	2186	560	3.5	981	873	.910	71	65
71/0	.503	2181	560	3.6	997	658	.910	72	66
77/0	.500	2186	560	3.5	1479	851	.911	107	97
82/1	.501	2184	560	3.5	1505	663	.914	109	99
83/0	.492	2197	560	3.5	1992	657	.925	141	131
88/0	.503	2179	560	3.6	2001	845	.922	143	132
69/0	.701	1867	560	4.5	0	0	.955	0	0
66/0	.702	1865	560	4.5	238	826	.885	21	18
57/0	.707	1857	560	4.5	262	631	.888	23	20
60/0	.705	1861	560	4.5	496	656	.877	44	38
63/1	.703	1865	560	4.5	490	859	.880	43	38
75/0	.703	1863	560	4.5	989	874	.846	90	76
72/0	.706	1859	560	4.5	1025	648	.845	94	79
81/0	.702	1866	560	4.5	1496	643	.862	134	115
78/0	.707	1858	560	4.5	1493	852	.859	135	116
84/0	.698	1876	560	4.5	1999	655	.882	174	153
87/0	.698	1873	560	4.5	2000	850	.880	175	154
70/0	.898	1536	560	5.1	0	0	.925	0	0
65/0	.898	1536	560	5.1	235	833	.819	27	22
58/0	.910	1515	560	5.1	243	646	.824	28	23
64/0	.901	1531	560	5.1	489	868	.800	58	46
59/0	.892	1546	560	5.1	495	668	.805	57	46
74/1	.901	1531	560	5.1	989	848	.743	125	93
73/0	.898	1536	560	5.1	1002	652	.747	126	94

TABLE A-2. (Continued)

ID.	FREESTREAM				CHAMBER		BASE		
RUN/ RERUN	M	P (PSFA)	TT (°R)	RE/L (M/FT)	PC (PSIA)	TC (°R)	PB/P	PC/PB	PC/P
80/0	.893	1543	560	5.1	1482	663	.778	178	138
79/0	.902	1529	560	5.1	1484	868	.770	182	140
86/0	.903	1529	560	5.1	1985	845	.805	232	187
85/0	.898	1536	560	5.1	1996	653	.806	232	187
TEST 1 (EDGE TAP) -- G1,N34 (AIR, A/A=4.0, 25 DEG.)									
472/0	.903	1528	561	5.1	0	0	.915	0	0
423/0	.900	1533	562	5.1	477	679	.767	58	45
455/0	.899	1534	563	5.1	490	815	.770	60	46
454/0	.895	1542	563	5.0	840	834	.861	91	78
422/0	.904	1526	562	5.1	910	677	.870	99	86
457/0	.893	1543	560	5.1	943	1001	.881	100	88
425/0	.905	1524	561	5.1	1023	523	.908	107	97
453/0	.878	1570	557	5.1	1322	815	.917	132	121
421/0	.907	1522	562	5.1	1322	685	.944	132	125
459/0	.900	1532	561	5.1	1617	1010	.982	155	152
452/0	.902	1529	558	5.1	1649	834	.981	158	155
420/0	.905	1524	563	5.1	1636	686	.985	157	155
473/0	1.199	1071	561	5.4	0	0	.747	0	0
448/0	1.204	1063	562	5.4	394	800	.626	85	53
416/0	1.201	1067	564	5.4	490	661	.665	99	66
462/0	1.213	1052	561	5.4	886	976	.799	152	121
417/0	1.201	1067	564	5.4	913	676	.802	154	123
449/0	1.200	1069	561	5.4	918	844	.806	153	124
430/0	1.204	1063	561	5.4	1003	512	.848	160	136
418/0	1.201	1067	563	5.4	1314	685	.894	198	177
450/0	1.197	1073	561	5.4	1326	878	.904	197	178
451/0	1.195	1075	561	5.4	1464	872	.930	211	196
419/0	1.202	1066	563	5.4	1595	689	.959	225	215
460/0	1.204	1063	561	5.4	1662	1003	.978	230	225
474/0	1.466	741	563	5.2	0	0	.708	0	0
415/0	1.446	762	564	5.2	470	671	.714	124	89
447/0	1.449	760	560	5.3	513	907	.735	132	97
414/0	1.463	745	565	5.2	914	693	.877	202	177
467/0	1.466	742	561	5.3	914	983	.887	200	177
446/0	1.464	743	560	5.3	933	891	.886	204	181



TABLE A-2. (Continued)

ID.	FREESTREAM				CHAMBER		BASE		
RUN/ RERUN	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P
		(PSFA)	(OR)	(M/FT)	(PSIA)	(OR)			
433/0	1.477	731	561	5.2	1077	527	.953	223	212
413/0	1.461	747	565	5.2	1276	706	.972	253	246
445/0	1.464	744	560	5.3	1345	855	.981	265	260
412/0	1.473	734	564	5.2	1591	745	1.047	298	312
444/0	1.469	739	559	5.3	1626	858	1.054	301	317
465/0	1.466	742	561	5.3	1638	987	1.053	302	318
475/0	3.480	175	559	10.4	0	0	.436	0	0
471/0	3.480	175	561	10.3	390	927	.882	364	321
440/0	3.480	175	561	10.3	459	818	.936	404	378
408/0	3.480	175	559	10.4	491	696	.940	430	404
470/0	3.480	175	561	10.3	822	970	1.198	566	677
409/0	3.480	175	559	10.4	896	697	1.221	605	738
441/0	3.480	175	561	10.3	918	820	1.242	609	756
438/1	3.480	175	561	10.3	1011	600	1.354	615	833
442/0	3.480	175	560	10.4	1241	821	1.399	731	1023
469/0	3.480	175	561	10.3	1288	987	1.446	734	1061
410/0	3.480	175	559	10.4	1292	684	1.439	739	1064
411/0	3.480	175	560	10.4	1640	678	1.581	854	1350
443/0	3.480	175	560	10.4	1649	828	1.564	868	1358
468/0	3.480	175	561	10.3	1679	978	1.587	871	1383
TEST 1 (EDGE TAP) -- G2,N33 (CF4, A/A=8.0, 15 DEG.)									
635/0	.906	1523	556	5.1	0	0	.913	0	0
615/0	.894	1543	577	4.9	830	839	.773	100	77
616/0	.901	1531	557	5.1	1145	848	.814	132	108
607/0	.906	1524	561	5.1	1513	754	.855	167	143
617/0	.901	1531	558	5.1	1558	870	.869	169	147
634/0	.902	1528	569	5.0	1620	1031	.895	171	153
618/0	.901	1532	558	5.1	1866	870	.906	194	175
636/0	1.200	1070	557	5.5	0	0	.745	0	0
622/0	1.193	1079	557	5.5	825	848	.641	172	110
621/0	1.201	1068	558	5.4	1225	857	.730	226	165
620/0	1.202	1067	558	5.4	1552	867	.786	267	210
633/0	1.178	1078	569	5.2	1606	1029	.819	262	215
608/0	1.212	1054	559	5.4	1586	795	.780	278	217
619/0	1.210	1056	559	5.4	1880	837	.831	308	256

TABLE A-2. (Concluded)

ID.	FREESTREAM				CHAMBER		BASE		
RUN/ RERUN	M	P (PSFA)	TT (OR)	RE/L (M/FT)	PC (PSIA)	TC (OR)	PB/P	PC/PB	PC/P
637/0	1.454	755	558	5.3	0	0	.707	0	0
623/0	1.453	756	558	5.3	848	851	.712	227	162
632/0	1.461	747	559	5.3	1118	987	.799	270	216
624/0	1.459	750	558	5.3	1213	840	.800	291	233
612/0	1.462	746	560	5.3	1210	1015	.826	283	234
609/0	1.457	751	558	5.3	1260	610	.792	305	242
625/0	1.467	740	558	5.3	1556	844	.864	350	303
626/0	1.476	731	559	5.3	1916	848	.922	409	377
638/0	3.480	175	567	10.2	0	0	.185	0	0
630/0	3.480	175	567	10.2	813	859	.815	821	670
629/0	3.480	175	567	10.2	1185	842	1.001	974	975
611/0	3.480	175	567	10.2	1459	924	1.159	1036	1202
628/0	3.480	175	567	10.2	1464	857	1.127	1070	1206
610/0	3.480	175	566	10.2	1519	797	1.113	1124	1250
631/0	3.480	175	568	10.1	1618	1012	1.251	1065	1333
627/0	3.480	175	566	10.2	1795	855	1.246	1185	1477

TABLE A-3. TEST DATA OF PRIMARY INTEREST — ET/SRB CLASS

ID.	FREESTREAM				CHAMBER		ET BASE			SRB INBOARD BASE		
RUN/ RERUN	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P	PB/P	PC/PB	PC/P
	(PSFA)	(OR)	(M/FT)		(PSIA)	(OR)						
TEST 7	---				G1,N24	(AIR, A/A=8.0, 35 DEG.)						
61/1	.500	590	540	1.0	0	0	.984	0	0	.959	0	0
72/2	.499	1220	549	2.0	790	664	.989	94	93	.939	99	93
61/2	.499	593	540	1.0	397	881	.984	98	96	.947	102	96
50/2	.499	1220	545	2.0	823	923	.988	98	97	.940	103	97
65/2	.500	591	540	1.0	428	679	.985	106	104	.947	110	104
49/2	.501	1220	546	2.0	1188	952	.990	142	140	.960	146	140
73/4	.498	1220	549	2.0	1320	659	.991	157	156	.966	161	156
40/2	.498	1220	542	2.0	1454	885	.991	173	172	.973	176	172
86/2	.498	1221	545	2.0	1564	649	.993	186	184	.974	189	184
60/1	.900	587	545	2.0	0	0	.955	0	0	.862	0	0
60/2	.907	585	545	2.0	386	855	.981	97	95	.867	110	95
64/2	.899	595	543	2.1	438	683	.976	109	106	.889	119	106
51/2	.898	855	546	2.9	813	910	.993	138	137	.939	146	137
71/2	.899	857	550	2.9	831	664	.994	141	140	.946	148	140
48/2	.897	857	547	2.9	1167	936	1.017	193	196	1.007	195	196
74/2	.900	856	550	2.9	1260	666	1.020	208	212	1.020	208	212
41/2	.895	856	544	2.9	1470	893	1.034	239	247	1.050	236	247
85/2	.898	855	546	2.9	1523	649	1.041	246	257	1.060	242	257
62/1	1.053	596	543	2.6	0	0	.802	0	0	.662	0	0
62/2	1.052	598	543	2.6	400	880	.864	112	96	.775	124	96
63/2	1.051	596	544	2.6	439	705	.875	121	106	.801	132	106
52/2	1.049	718	546	3.1	814	934	.938	174	163	.950	172	163
70/8	1.048	720	551	3.0	813	651	.940	173	163	.961	169	163
47/2	1.047	719	550	3.0	1171	961	1.002	234	234	1.043	225	234
75/2	1.052	719	553	3.0	1268	663	1.018	249	254	1.072	237	254
59/4	1.053	716	550	3.0	1520	927	1.051	291	306	1.103	277	306
84/2	1.047	724	546	3.1	1571	640	1.055	296	313	1.109	282	313
56/1	1.200	592	553	3.0	0	0	.783	0	0	.551	0	0
56/2	1.199	594	553	3.0	403	931	.846	115	98	.767	127	98
66/2	1.201	595	551	3.1	439	664	.848	125	106	.774	137	106
53/2	1.200	594	550	3.1	801	946	.938	207	194	.966	201	194
69/2	1.199	598	551	3.1	842	674	.933	217	203	.981	207	203
46/2	1.200	594	553	3.1	1152	973	1.013	276	279	1.072	260	279
76/2	1.198	596	553	3.1	1255	671	1.020	297	303	1.102	275	303

TABLE A-3. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		ET BASE			SRB INBOARD BASE		
	M	P (PSFA)	TT (OR)	RE/L (M/FT)	PC (PSIA)	TC (OR)	PB/P	PC/PB	PC/P	PB/P	PC/PB	PC/P
43/3	1.199	594	551	3.1	1420	923	1.056	326	344	1.122	307	344
79/3	1.197	599	556	3.0	1580	677	1.073	354	380	1.160	328	380
55/2	1.301	518	552	3.0	0	0	.780	0	0	.506	0	0
55/3	1.301	519	552	3.1	373	884	.851	122	103	.764	135	103
67/2	1.301	521	552	3.1	438	872	.866	140	121	.814	149	121
68/2	1.299	521	553	3.1	776	697	.944	227	214	.987	217	214
54/2	1.302	519	551	3.1	799	964	.952	233	222	.997	223	222
45/3	1.301	520	553	3.1	1178	975	1.023	319	326	1.105	295	326
77/3	1.299	523	554	3.0	1269	698	1.035	338	349	1.133	306	349
44/2	1.300	520	552	3.1	1514	976	1.076	389	419	1.161	361	419
78/2	1.299	523	555	3.1	1612	702	1.086	408	444	1.189	373	444
164/3	2.000	184	580	2.3	0	0	.596	0	0	.359	0	0
164/4	1.998	185	581	2.3	395	964	.814	379	308	.963	320	308
163/2	1.996	185	580	2.3	811	970	.990	639	632	1.015	623	632
162/2	1.997	185	583	2.3	1163	977	1.145	792	907	1.121	809	907
161/3	1.997	185	583	2.3	1517	965	1.082	1092	1182	1.127	1048	1182
TEST 7 --- G1,N23 (AIR, A/A=5.0, 25 DEG.)												
109/2	.500	1212	542	2.1	0	0	.989	0	0	.953	0	0
114/2	.503	1212	546	2.0	460	0	.987	55	55	.927	59	55
121/2	.501	1216	549	2.0	872	986	.989	104	103	.959	108	103
109/3	.496	1218	542	2.0	1256	0	.992	150	148	.980	151	148
110/1	.898	851	545	2.9	0	0	.965	0	0	.848	0	0
113/2	.901	850	547	2.9	458	0	.950	78	78	.884	88	78
111/2	.900	854	546	2.9	870	0	1.025	143	147	1.009	145	147
110/2	.892	865	546	2.9	1274	992	1.054	201	212	1.076	197	212
122/2	1.053	713	552	3.0	0	0	.815	0	0	.689	0	0
115/2	1.048	723	548	3.1	476	0	.919	103	95	.879	108	95
120/2	1.043	723	554	3.0	864	953	1.014	170	172	1.064	162	172
122/3	1.043	722	552	3.0	1259	945	1.052	239	251	1.137	221	251
119/1	1.201	594	556	3.0	0	0	.766	0	0	.621	0	0
116/2	1.200	595	548	3.1	442	0	.893	120	107	.874	122	107
119/2	1.198	599	556	3.1	879	991	1.022	207	211	1.079	196	211
118/2	1.302	518	555	3.0	0	0	.755	0	0	.543	0	0
117/2	1.301	519	553	3.0	472	0	.893	147	131	.901	145	131
118/3	1.300	521	555	3.0	881	946	1.025	238	244	1.081	225	244



TABLE A-3. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		ET BASE			SRB INBOARD BASE		
	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P	PB/P	PC/PB	PC/P
	(PSFA)	(OR)	(M/FT)		(PSIA)	(OR)						
123/2	1.297	521	554	3.0	1300	1023	1.085	331	360	1.159	310	360
170/4	1.991	187	571	2.4	0	0	.612	0	0	.350	0	0
172/2	1.987	187	572	2.4	439	955	.971	348	338	.861	392	338
171/2	1.986	187	572	2.4	855	978	1.192	551	657	1.028	639	657
170/5	1.991	187	571	2.4	1269	992	1.247	785	979	1.188	824	979
TEST 7 --- G2, N22 (CF4, A/A=8.0, 15 DEG.)												
128/1	.500	597	539	1.0	0	0	.982	0	0	.961	0	0
137/2	.498	1218	569	1.9	802	0	.969	96	95	.954	99	95
128/2	.500	596	539	1.0	405	894	.984	99	98	.954	103	98
138/3	.497	1215	554	2.0	1117	0	.990	134	132	.969	137	132
148/1	.899	856	551	2.9	0	0	.959	0	0	.846	0	0
129/2	.898	599	543	2.1	378	848	.978	93	91	.865	105	91
136/2	.896	857	569	2.8	820	0	.999	138	138	.954	145	138
139/2	.895	855	553	2.9	1240	0	1.036	201	209	1.041	201	209
147/1	1.053	714	554	3.0	0	0	.809	0	0	.685	0	0
130/2	1.049	596	544	2.5	385	901	.869	107	93	.773	120	93
135/2	1.046	720	569	2.9	806	0	.956	169	161	.969	166	161
140/2	1.044	721	553	3.0	1241	0	1.040	238	248	1.085	229	248
147/2	1.048	719	555	3.0	1540	964	1.065	290	308	1.131	273	308
146/1	1.203	591	558	3.0	0	0	.766	0	0	.625	0	0
131/2	1.199	597	551	3.1	384	907	.835	111	93	.727	127	93
134/3	1.197	596	570	2.9	788	0	.944	202	190	.958	199	190
142/2	1.198	595	558	3.0	1243	0	1.048	287	301	1.112	270	301
146/2	1.198	595	558	3.0	1536	990	1.066	349	372	1.160	320	372
145/1	1.301	526	554	3.1	0	0	.726	0	0	.564	0	0
132/2	1.300	518	552	3.0	380	904	.794	133	106	.741	143	106
133/2	1.300	519	570	2.9	784	1005	.931	234	218	.963	226	218
141/2	1.300	519	568	2.9	1247	0	1.055	328	346	1.115	310	346
145/2	1.298	522	554	3.0	1531	974	1.096	385	422	1.162	363	422
154/1	1.991	186	582	2.3	0	0	.580	0	0	.336	0	0
156/4	1.989	188	582	2.3	402	958	.823	375	308	.642	480	308
155/2	1.989	188	583	2.3	793	1016	1.028	590	607	.849	715	607
154/2	1.983	187	583	2.3	1185	1042	1.090	835	911	1.088	837	911



TABLE A-3. (Concluded)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		ET BASE			SRB INBOARD BASE		
	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P	PB/P	PC/PB	PC/P
	(PSFA)	(OR)	(M/FT)		(PSIA)	(OR)						
TEST 8	---				G5,N21	(16%)	A/A=3.1, 20 DEG.)					
1	.492	1199	541	2.0	0	0	.977	0	0	.948	0	0
14	.495	2027	541	3.4	154	6330	.985	11	11	.947	12	11
31	.499	1163	536	2.0	137	6330	1.012	17	17	.962	18	17
20	.498	805	533	1.4	155	6330	1.016	27	28	.993	28	28
33	.501	882	536	1.5	195	6330	1.030	31	32	1.002	32	32
21	.499	589	531	1.0	226	6330	1.038	53	55	1.054	52	55
2	.895	841	543	2.9	0	0	.936	0	0	.836	0	0
7	.897	1483	547	5.1	122	6330	1.006	12	12	.867	14	12
24	.902	1064	542	3.7	168	6330	1.041	22	23	.965	24	23
6	.900	916	542	3.2	216	6330	1.068	32	34	1.064	32	34
25	.901	522	541	1.8	160	6330	1.093	40	44	1.110	40	44
8	.902	627	543	2.2	212	6330	1.136	43	49	1.133	43	49
17	1.052	534	542	2.3	0	0	.812	0	0	.720	0	0
15	1.048	1384	556	5.7	159	6330	.971	17	17	.872	19	17
27	1.048	854	543	3.7	156	6330	1.013	26	26	1.007	26	26
17	1.055	532	541	2.3	156	6330	1.077	39	42	1.159	36	42
28	1.051	404	542	1.7	157	6330	1.137	49	56	1.225	46	56
19	1.056	430	542	1.9	219	6330	1.208	61	73	1.284	57	73
5	1.095	666	544	3.0	0	0	.831	0	0	.630	0	0
5	1.098	664	548	3.0	152	6330	1.005	33	33	1.064	31	33
4	1.195	587	545	3.1	0	0	.753	0	0	.616	0	0
10	1.197	1241	569	6.1	124	6330	.855	17	14	.751	19	14
22	1.195	848	553	4.3	122	6330	.908	23	21	.850	24	21
9	1.203	625	547	3.3	158	6330	1.005	36	37	1.067	34	37
23	1.202	457	542	2.4	163	6330	1.095	47	51	1.164	44	51
11	1.200	409	542	2.2	226	6330	1.131	70	79	1.297	61	79
3	1.296	513	553	3.0	0	0	.680	0	0	.552	0	0
12	1.292	645	553	3.7	134	6330	.852	35	30	.898	33	30
30	1.294	772	556	4.5	165	6330	.828	37	31	.858	36	31
26	1.291	692	551	4.0	174	6330	.886	41	36	.938	39	36
32	1.294	494	546	2.9	145	6330	.936	45	42	1.004	42	42
13	1.297	493	547	2.9	164	6330	.960	50	48	1.086	44	48
29	1.297	348	542	2.1	138	6330	.998	57	57	1.102	52	57
16	1.297	363	541	2.2	225	6330	1.143	78	89	1.248	71	89

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TABLE A-4. TEST DATA OF PRIMARY INTEREST —  
SRB-ALONE CLASS

ID.	FREESTREAM				CHAMBER		BASE		
RUN/ RERUN	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P
	(PSFA)	(°R)	(M/FT)	(PSIA)	(°R)				
TEST 10	(F1)	---		G2,N11	(CF4, A/A=8.0,	15 DEG.)			
104/0	.507	2193	549	3.7	717	895	.921	51	47
105/0	.506	2192	549	3.7	900	928	.933	63	59
106/0	.504	2194	549	3.7	1131	945	.945	79	74
107/0	.505	2194	549	3.7	1324	962	.953	91	87
103/0	.901	1541	549	5.3	628	898	.775	76	59
102/0	.899	1545	549	5.3	812	926	.831	91	76
101/0	.901	1544	549	5.3	1005	946	.879	107	94
100/0	.904	1541	549	5.3	1388	977	.956	136	130
96/0	1.197	1083	549	5.6	478	821	.645	99	64
97/0	1.196	1084	549	5.6	708	886	.757	124	94
98/0	1.195	1085	549	5.6	983	927	.860	152	130
99/1	1.196	1083	549	5.6	1440	977	1.009	190	191
92/0	1.464	828	560	5.9	451	828	.671	117	78
94/1	1.456	837	549	6.0	1056	956	.924	197	182
95/0	1.449	846	549	6.0	1568	954	1.045	256	267
88/2	1.969	541	558	7.0	706	870	.759	248	188
89/1	1.959	550	559	7.0	1133	932	.906	328	297
111/9	3.481	97	549	5.9	0	0	.422	0	0
108/1	3.481	97	549	5.9	204	768	.599	508	304
109/0	3.481	97	549	5.9	466	852	.804	863	694
110/0	3.481	97	562	5.7	800	922	1.084	1098	1190
111/0	3.481	97	549	5.9	1426	973	1.385	1532	2122
TEST 10	(F1)	---		G1,N12	(AIR, A/A=5.0,	25 DEG.)			
47/9	.510	2180	557	3.6	0	0	.954	0	0
50/0	.505	2187	559	3.6	369	0	.913	27	24
49/0	.505	2186	558	3.6	461	0	.921	33	30
48/0	.506	2185	558	3.6	593	0	.932	42	39
47/1	.506	2185	557	3.6	757	0	.943	53	50
51/9	.903	1534	558	5.1	0	0	.862	0	0
51/0	.898	1542	553	5.2	335	0	.745	42	31
52/0	.897	1545	557	5.1	441	0	.803	51	41
53/0	.897	1544	558	5.1	633	0	.881	67	59
54/0	.896	1544	558	5.1	880	0	.945	87	82
55/9	1.200	1073	557	5.5	0	0	.723	0	0

TABLE A-4. (Continued)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P (PSFA)	TT (OR)	RE/L (M/FT)	PC (PSIA)	TC (OR)	PB/P	PC/PB	PC/P
58/0	1.199	1074	559	5.4	274	0	.672	55	37
57/0	1.197	1077	559	5.4	427	0	.783	73	57
56/0	1.198	1076	558	5.5	721	0	.931	104	96
55/0	1.201	1072	558	5.5	1133	0	1.086	140	152
59/6	1.467	825	559	5.9	0	0	.551	0	0
62/0	1.467	825	559	5.9	255	0	.712	62	44
61/1	1.472	819	558	5.9	442	0	.852	91	78
60/0	1.462	830	558	5.9	798	0	1.004	138	138
59/0	1.467	825	558	5.9	1296	0	1.149	197	226
63/8	1.959	550	558	7.0	0	0	.455	0	0
63/0	1.961	548	549	7.2	225	0	.673	88	59
64/0	1.958	551	549	7.2	395	0	.814	127	103
65/0	1.958	551	549	7.2	679	0	.952	186	177
66/0	1.961	548	549	7.2	1351	0	1.156	307	355
46/9	3.481	97	549	5.9	0	0	.283	0	0
46/0	3.481	97	549	5.9	213	0	.761	416	316
45/0	3.481	97	549	5.9	513	0	1.029	740	761
44/0	3.481	97	549	5.9	1048	0	1.303	1193	1555
43/0	3.481	97	549	5.9	1349	0	1.388	1442	2002
TEST 10 (F2) --- G1,N12 (AIR, A/A=5.0, 25 DEG.)									
27/9	.508	2176	549	3.7	0	0	.947	0	0
27/0	.510	2173	549	3.7	365	0	.886	27	24
28/0	.509	2175	549	3.7	461	0	.894	34	31
29/0	.508	2177	549	3.7	573	0	.907	42	38
30/0	.507	2178	549	3.7	744	0	.920	53	49
23/9	.883	1568	549	5.2	0	0	.838	0	0
26/0	.906	1526	549	5.2	330	0	.632	49	31
25/0	.908	1523	549	5.3	443	0	.707	59	42
24/1	.905	1527	549	5.2	651	0	.808	76	61
23/0	.887	1561	549	5.2	918	0	.888	95	85
19/9	1.212	1053	549	5.6	0	0	.677	0	0
19/0	1.201	1068	549	5.6	273	0	.608	61	37
20/0	1.197	1077	549	5.6	420	0	.717	78	56
21/0	1.203	1067	549	5.6	709	0	.862	111	96
22/0	1.201	1072	549	5.6	1098	0	1.012	146	147



TABLE A-4. (Concluded)

ID. RUN/ RERUN	FREESTREAM				CHAMBER		BASE		
	M	P	TT	RE/L	PC	TC	PB/P	PC/PB	PC/P
		(PSFA)	(°R)	(M/FT)	(PSIA)	(°R)			
15/9	1.465	826	549	6.0	0	0	.496	0	0
18/0	1.462	830	549	6.0	252	0	.643	68	44
17/0	1.466	825	549	6.0	439	0	.785	97	77
16/0	1.465	826	549	6.0	792	0	.943	146	138
15/0	1.461	831	559	5.9	1327	0	1.102	209	230
11/1	1.958	552	558	7.0	220	0	.574	100	57
12/0	1.965	545	559	7.0	390	0	.722	143	103
13/0	1.979	533	549	7.1	657	0	.866	205	177
14/0	1.960	549	559	7.0	1297	0	1.072	317	340
31/8	3.481	97	549	5.9	0	0	.315	0	0
34/0	3.480	97	549	5.9	220	0	.756	431	326
33/1	3.480	97	549	5.9	493	0	1.031	710	732
31/1	3.480	97	549	5.9	1048	0	1.326	1174	1556
32/1	3.480	97	549	5.9	1254	0	1.407	1324	1863

## APPENDIX B

### COMPLETE PRESSURE DATA

The complete base, body, and nozzle pressure data for each valid wind-on run of the seven selected tests are presented in this appendix. Locations of the various pressure ports are shown in Tables 6 and 7 of text. Corresponding model chamber conditions and tunnel freestream parameters are given in Appendix A. Because of the significant geometry difference between the base/body region and the nozzles, these two types of data are presented in separate tables. Base and body pressures are given in Tables B-1 through B-4 for all of the cases given in Appendix A, both jet-on and jet-off. Nozzle wall pressures are given in Tables B-5 through B-8 for only jet-on runs. The following index relates these tables to the four body geometry types for the two types of pressure data. In all cases, the sequence of presentation of runs is identical to that of Appendix A.

#### INDEX TO TABLES

Class	Pressure Data			
	Base and Body		Nozzle Wall	
	Table	Page	Table	Page
Classic Geometry	B-1	76	B-5	156
Orbiter Class	B-2	103	B-6	161
ET/SRB Class	B-3	127	B-7	165
SRB-Alone Class	B-4	150	B-8	170

An example is given of obtaining the model chamber and tunnel free-stream conditions for a particular case: Run 356/0 of Test 1. This case is the second one presented in this appendix within the classic geometry shape (see Table B-1) below. Thus, the desired data will be found at the second case presented in Appendix A. At that location the following values are found:

$$M_{\infty} = 0.888$$

$$P_{\infty} = 1553 \text{ psfa}$$

$$T_{T_{\infty}} = 563^{\circ}\text{R}$$

$$\text{Re} = 5.0 \times 10^6 / \text{ft}$$

$$P_c = 466 \text{ psia}$$

$$T_c = 958^{\circ}\text{R.}$$

Correspondingly, the desired nozzle wall pressure data will be found in the classic geometry portion of the nozzle section of this appendix (Table B-5). Because jet-off runs are not included in the nozzle section, the desired nozzle data will be found at the  $i$ th position:  $i = j - n_{\text{off}}$ , where the base and body case is the  $j$ th position and  $n_{\text{off}}$  is the number of jet-off runs up to position  $j$ . In this example,  $j = 2$  and  $n_{\text{off}} = 1$  so  $i = 1$ . At that location the value of  $P_c / P_{\infty}$  for Tap No. 47 is found to be 26.45.

Nozzle calibration data (wind-off) are given in Appendix C.

TABLE B-1. BASE AND BODY SURFACE PRESSURE RATIOS ( $P/P_{\infty}$ ) FOR CLASSIC GEOMETRY

		(A) B1A1											
X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 372/0			TEST 1, RUN 356/0			TEST 1, RUN 323/0			TEST 1, RUN 357/0		
0	.52	.915	.898		.850	.854		.845	.849		.940	.948	
0	.64	.948	.904	.902	.846	.847	.856	.841	.843	.851	.933	.936	.948
.03	1.0	.935	.919	.935	.892	.875	.906	.891	.875	.903	.952	.939	.966
.22	1.0	.948	.963		.000	.949		.000	.948		.000	.979	
.40	1.0	.976	.978		.968	.966		.966	.968		.987	.985	
.58	1.0	.980	.979		.973	.973		.973	.975		.987	.988	
.76	1.0	.979	.986	1.015	.976	.982	1.013	.977	.985	1.014	.987	.993	1.027
.94	1.0	1.013	.999		1.011	.992		1.013	.997		1.019	.999	
1.12	1.0	.978	.992	1.022	.978	.992	1.019	.976	.991	1.023	.983	.998	1.026
1.30	1.0	.983	.989		.986	.991		.983	.989		.990	.995	
1.48	1.0	.973	.972		.972	.972		.970	.970		.976	.975	
1.84	1.0	.966			.970			.967			.971		
2.20	1.0	.962	.948	1.042	.968	.956	1.044	.963	.949	1.043	.967	.954	1.041
2.56	1.0	.956			.961			.955			.958		
2.92	1.0	.963	.963		.971	.969		.964	.965		.969	.967	
3.28	1.0	.979			.980			.977			.980		
		TEST 1, RUN 354/0			TEST 1, RUN 322/0			TEST 1, RUN 353/0			TEST 1, RUN 358/0		
0	.52	.943	.954		.973	.982		1.000	1.015		1.003	1.012	
0	.84	.939	.946	.951	.967	.970	.981	.994	1.002	1.006	.995	1.000	1.010
.03	1.0	.959	.951	.969	.980	.966	.991	1.005	1.000	1.012	1.005	.996	1.015
.22	1.0	.000	.984		.000	.993		.000	1.011		.000	1.011	
.40	1.0	.988	.993		.996	.998		1.007	1.010		1.008	1.007	
.58	1.0	.991	.993		.994	.996		1.003	1.007		1.003	1.003	
.76	1.0	.991	1.000	1.026	.993	1.000	1.031	1.002	1.010	1.036	.998	1.006	1.038
.94	1.0	1.023	1.007		1.023	1.007		1.030	1.014		1.027	1.010	
1.12	1.0	.985	1.000	1.030	.984	1.002	1.033	.992	1.006	1.036	.991	1.004	1.031
1.30	1.0	.989	.996		.991	.996		.995	1.001		.995	1.000	
1.48	1.0	.977	.979		.977	.977		.981	.982		.981	.980	
1.84	1.0	.972			.971			.976			.974		
2.20	1.0	.970	.955	1.042	.963	.951	1.042	.970	.958	1.044	.969	.955	1.043
2.56	1.0	.958			.954			.960			.959		
2.92	1.0	.968	.972		.963	.964		.969	.971		.969	.967	
3.28	1.0	.986			.977			.985			.980		

TABLE B-1. (Continued)

(A) CONTINUED.

X/D	P/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 321/0			TEST 1, RUN 359/0			TEST 1, RUN 352/0			TEST 1, RUN 320/0		
0	.52	1.056	1.065		1.037	1.050		1.047	1.058		1.074	1.115	
0	.84	1.047	1.048	1.059	1.029	1.035	1.041	1.037	1.044	1.047	1.087	1.096	1.075
.03	1.0	1.048	1.036	1.059	1.034	1.028	1.043	1.043	1.039	1.049	1.082	1.085	1.092
.22	1.0	.000	1.039		.000	1.029		.000	1.036		.000	1.050	
.40	1.0	1.029	1.032		1.021	1.022		1.027	1.028		1.036	1.051	
.58	1.0	1.020	1.020		1.014	1.015		1.017	1.020		1.034	1.041	
.76	1.0	1.012	1.018	1.048	1.008	1.014	1.047	1.012	1.020	1.046	1.027	1.033	1.063
.94	1.0	1.037	1.020		1.033	1.015		1.037	1.023		1.047	1.035	
1.12	1.0	.995	1.013	1.044	.994	1.008	1.036	.999	1.014	1.042	1.008	1.018	1.053
1.30	1.0	1.000	1.006		.999	1.004		1.003	1.009		1.000	1.005	
1.48	1.0	.986	.986		.985	.984		.985	.986		.990	.989	
1.64	1.0	.975			.976			.978			.979		
2.20	1.0	.967	.954	1.043	.968	.937	1.044	.972	.959	1.045	.970	.958	1.050
2.56	1.0	.955			.957			.961			.962		
2.92	1.0	.965	.964		.968	.966		.972	.971		.962	.964	
3.28	1.0	.980			.981			.985			.979		
		TEST 1, RUN 373/0			TEST 1, RUN 363/0			TEST 1, RUN 316/0			TEST 1, RUN 362/0		
0	.52	.734	.734		.721	.716		.756	.744		.886	.874	
0	.84	.913	.744	.770	.709	.707	.723	.741	.733	.745	.864	.860	.879
.03	1.0	.738	.894	.933	.911	.892	.939	.917	.901	.926	.927	.906	.934
.22	1.0	.944	.981		.000	.977		.000	.986		.000	.975	
.40	1.0	.990	.993		.963	.988		.996	.978		.978	.977	
.58	1.0	1.003	.966		1.000	.977		1.005	.981		.972	.963	
.76	1.0	.999	.998	1.024	1.000	.991	1.021	1.017	1.018	1.017	.985	.971	1.002
.94	1.0	1.050	1.033		1.048	1.021		1.042	1.028		1.021	.997	
1.12	1.0	1.005	1.031	.992	1.010	1.039	1.003	1.001	1.026	.996	.987	1.011	1.011
1.30	1.0	1.008	1.016		1.014	1.027		1.000	1.029		1.029	1.017	
1.48	1.0	1.007	1.006		1.011	1.002		.994	1.009		1.004	1.008	
1.64	1.0	.934			.951			.943			1.027		
2.20	1.0	.958	.917	1.130	.953	.924	1.140	.978	.930	1.112	.965	.975	1.129
2.56	1.0	.964			.979			.966			.945		
2.92	1.0	.971	1.013		.966	1.001		.976	.993		.984	.972	
3.28	1.0	.982			.982			.992			.986		



TABLE B-1. (Continued)

(A) CONTINUED.													
X/D	P/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
TEST 1, RUN 349/0													
0	.52	.893	.884		.926	.972		.997	.991		1.013	1.001	
0	.84	.873	.872	.880	.967	.958	.978	.979	.980	.988	.993	.988	1.005
.03	1.0	.940	.924	.939	.974	.954	.952	.982	.972	.962	.990	.974	.987
.22	1.0	.000	.993		.000	.988		.000	.994		.970	.982	
.40	1.0	1.003	.997		.999	.979		.997	1.000		.982	.986	
.58	1.0	1.006	.982		1.004	.975		1.003	.980		.994	.980	
.76	1.0	1.013	1.016	1.027	1.015	1.013	1.018	1.008	1.013	1.025	1.001	.986	1.022
.94	1.0	1.054	1.036		1.043	1.029		1.053	1.034		1.044	1.015	
1.12	1.0	1.009	1.027	1.003	1.006	1.020	.996	1.009	1.033	1.001	1.012	1.034	1.011
1.30	1.0	1.005	1.021		1.002	1.022		1.008	1.022		1.015	1.037	
1.48	1.0	1.000	1.007		.994	1.007		1.005	1.007		1.009	1.006	
1.84	1.0	.940			.937			.936			.954		
2.20	1.0	.979	.929	1.124	.976	.924	1.124	.968	.927	1.127	.951	.929	1.132
2.56	1.0	.972			.965			.973			.982		
2.92	1.0	.977	1.008		.974	.997		.980	1.008		.989	.999	
3.28	1.0	.996			.992			.991			.985		
TEST 1, RUN 361/0													
0	.52	1.016	.999		1.067	1.068		1.136	1.145		1.089	1.006	
0	.84	.994	.985	1.005	1.058	1.053	1.059	1.138	1.126	1.132	1.074	1.074	1.082
.03	1.0	.992	.977	.969	1.028	1.022	1.022	1.089	1.079	1.073	1.046	1.040	1.019
.22	1.0	.000	1.000		.967	.986		.000	1.005		.000	.996	
.40	1.0	1.002	.977		.965	.983		1.002	.982		.995	.998	
.58	1.0	1.013	.992		.992	.979		1.005	.977		1.000	.976	
.76	1.0	1.024	1.022	1.022	.999	.986	1.018	1.017	1.015	1.016	1.002	1.010	1.019
.94	1.0	1.055	1.027		1.040	1.013		1.042	1.027		1.051	1.029	
1.12	1.0	.997	1.024	1.016	1.018	1.032	1.017	1.002	1.028	.996	1.005	1.027	.998
1.30	1.0	1.011	1.033		1.015	1.040		1.002	1.021		1.001	1.017	
1.48	1.0	.996	.995		1.003	1.007		.994	1.004		1.004	1.003	
1.84	1.0	.951			.962			.939			.930		
2.20	1.0	.987	.939	1.117	.946	.926	1.140	.977	.928	1.121	.964	.924	1.124
2.56	1.0	.974			.961			.966			.968		
2.92	1.0	.983	1.003		.988	1.000		.975	.995		.974	1.005	
3.28	1.0	.999			.988			.990			.986		
TEST 1, RUN 317/0													
TEST 1, RUN 350/0													
TEST 1, RUN 329/0													
TEST 1, RUN 318/0													
TEST 1, RUN 351/0													

TABLE B-1. (Continued)

(A) CONTINUED.													
X/D R/R		$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 360/0			TEST 1, RUN 319/0			TEST 1, RUN 374/0			TEST 1, RUN 347/0		
0	.52	1.108	1.098		1.198	1.215		.708	.790		.783	.787	
0	.84	1.092	1.081	1.101	1.207	1.194	1.197	.962	.914	.747	.766	.778	.776
.03	1.0	1.059	1.049	1.038	1.155	1.151	1.160	.713	.956	1.081	.960	.960	1.080
.22	1.0	.000	1.010		.000	1.031		.976	1.014		.000	1.015	
.40	1.0	1.003	.988		1.007	.985		.983	1.019		1.005	1.014	
.58	1.0	1.012	.992		1.004	.979		.957	1.020		.958	1.008	
.76	1.0	1.020	1.018	1.025	1.016	1.015	1.019	.923	.974	1.064	.940	.996	1.048
.94	1.0	1.052	1.029		1.042	1.028		.904	.946		.908	.940	
1.12	1.0	1.001	1.022	1.015	1.004	1.021	.997	.922	.936	1.135	.935	.933	1.122
1.30	1.0	1.013	1.030		1.004	1.023		.948	.944		.941	.957	
1.48	1.0	1.003	1.003		.993	1.004		.953	.910		.942	.913	
1.84	1.0	.949			.939			.951			.954		
2.20	1.0	.985	.939	1.119	.978	.929	1.123	.941	.933	.967	.945	.941	.964
2.56	1.0	.976			.966			.979			.963		
2.92	1.0	.986	1.004		.974	.997		.988	1.004		.993	1.008	
3.28	1.0	.993			.987			.990			.984		
		TEST 1, RUN 364/0			TEST 1, RUN 315/0			TEST 1, RUN 365/0			TEST 1, RUN 346/0		
0	.52	.792	.783		.816	.821		.959	.945		.946	.943	
0	.84	.770	.775	.781	.801	.809	.809	.924	.919	.927	.919	.924	.922
.03	1.0	.970	.959	1.077	.971	.967	1.097	.974	.958	1.073	.981	.953	1.074
.22	1.0	.000	1.002		.000	1.021		.000	1.020		.000	1.002	
.40	1.0	.958	1.021		1.012	1.016		.969	1.042		.966	1.039	
.58	1.0	.967	1.023		.955	1.021		.926	.984		.930	.985	
.76	1.0	.923	.980	1.064	.945	.990	1.055	.934	.966	1.063	.922	.957	1.058
.94	1.0	.937	.935		.905	.949		.940	.955		.917	.949	
1.12	1.0	.913	.940	1.139	.938	.935	1.124	.956	.927	1.140	.948	.947	1.146
1.30	1.0	.970	.936		.940	.950		.971	.935		.993	.937	
1.48	1.0	.966	.910		.948	.909		.934	.925		.935	.919	
1.84	1.0	.946			.954			.923			.931		
2.20	1.0	.949	.923	.964	.947	.934	.962	.955	.933	.969	.953	.932	.966
2.56	1.0	.982			.947			.952			.955		
2.92	1.0	.985	1.001		.999	1.005		.992	.966		.986	.970	
3.28	1.0	.994			.992			1.013			1.010		

TABLE B-1. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 314/0			TEST 1, RUN 345/0			TEST 1, RUN 366/0			TEST 1, RUN 313/0		
0	.52	1.017	1.010		1.046	1.040		1.071	1.054		1.158	1.153	
0	.84	.985	.990	.999	1.012	1.019	1.015	1.035	1.027	1.034	1.131	1.122	1.140
.03	1.0	.997	.968	1.081	1.008	.989	1.079	1.009	1.002	1.058	1.066	1.037	1.094
.22	1.0	.000	1.004		.000	1.011		.000	1.042		.000	1.000	
.40	1.0	.966	1.043		.968	1.044		.976	1.028		.964	1.038	
.58	1.0	.943	.993		.931	.989		.928	.987		.944	.990	
.76	1.0	.916	.961	1.061	.930	.963	1.062	.949	.969	1.063	.919	.959	1.061
.94	1.0	.900	.947		.924	.954		.939	.945		.898	.949	
1.12	1.0	.942	.953	1.172	.952	.943	1.145	.961	.925	1.131	.947	.947	1.168
1.30	1.0	.997	.937		.984	.941		.958	.940		.997	.933	
1.48	1.0	.939	.910		.936	.921		.935	.915		.946	.912	
1.64	1.0	.935			.928			.928			.938		
2.20	1.0	.953	.929	.974	.952	.934	.972	.954	.941	.974	.951	.928	.972
2.56	1.0	.965			.958			.941			.961		
2.92	1.0	.990	.971		.991	.972		.962	.972		.990	.971	
3.28	1.0	1.009			1.013			1.023			1.014		
		TEST 1, RUN 344/0			TEST 1, RUN 367/0			TEST 1, RUN 312/0			TEST 1, RUN 375/0		
0	.52	1.118	1.116		1.141	1.129		1.199	1.268		.246	.248	
0	.84	1.088	1.094	1.091	1.104	1.105	1.106	1.216	1.241	1.187	.981	.288	.289
.03	1.0	1.040	1.029	1.083	1.051	1.045	1.071	1.138	1.154	1.111	.248	1.286	.993
.22	1.0	.000	1.003		.000	1.037		.000	1.006		.985	3.820	
.40	1.0	.964	1.038		.976	1.024		.969	1.038		.993	.993	
.58	1.0	.927	.979		.924	.979		.954	1.001		.987	3.820	
.76	1.0	.920	.956	1.057	.945	.962	1.062	.927	.965	1.067	.965	.942	.954
.94	1.0	.926	.946		.939	.943		.902	.948		.982	.947	
1.12	1.0	.946	.941	1.153	.968	.925	1.136	.942	.949	1.173	.972	.964	.911
1.30	1.0	.995	.936		.963	.937		.998	.939		1.002	.978	
1.48	1.0	.932	.915		.931	.917		.948	.915		.961	.961	
1.64	1.0	.925			.924			.945			.989		
2.20	1.0	.953	.930	.966	.954	.934	.973	.959	.934	.973	.989	.977	.732
2.56	1.0	.954			.939			.973			.940		
2.92	1.0	.988	.969		.969	.970		.996	.980		.968	.966	
3.28	1.0	1.008			1.020			1.017			.983		

TABLE B-1. (Continued)

(A) CONTINUED.													
X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 376/0			TEST 1, RUN 340/0			TEST 1, RUN 308/1			TEST 1, RUN 370/0		
0	.52	.732	.704		.725	.704		.763	.737		.925	.886	
0	.84	.674	.678	.688	.665	.679	.679	.986	.703	.706	.836	.839	.852
.03	1.0	.960	.911	1.020	.996	.924	1.011	.696	.912	1.001	.984	.912	1.017
.22	1.0	.000	.934		.000	.944		1.472	.931		.000	.930	
.40	1.0	.996	.934		1.005	.946		.994	.935		.991	.932	
.58	1.0	.989	.932		.998	.941		.988	.930		.984	.928	
.76	1.0	.973	.939	.947	.979	.950	.961	.970	.930	.941	.967	.936	.949
.94	1.0	.947	.940		.930	.951		.933	.940		.946	.936	
1.12	1.0	.974	.969	.905	.982	.979	.916	.972	.966	.903	.969	.970	.908
1.30	1.0	1.005	.984		1.013	.993		1.002	.980		1.002	.984	
1.48	1.0	.971	.968		.966	.970		.965	.963		.961	.964	
1.64	1.0	.991			1.001			.992			.988		
2.20	1.0	.969	.981	.712	1.002	.986	.723	.990	.980	.708	.984	.979	.720
2.56	1.0	.947			.943			.940			.933		
2.92	1.0	.969	.968		.980	.993		.969	.966		.965	.965	
3.28	1.0	.986			1.005			.991			.986		
		TEST 1, RUN 341/0			TEST 1, RUN 379/0			TEST 1, RUN 337/0			TEST 1, RUN 309/0		
0	.52	.954	.924		.925	.891		1.107	1.056		1.194	1.169	
0	.84	.863	.883	.876	.833	.844	.852	.992	.987	1.019	1.090	1.095	1.090
.03	1.0	.999	.928	1.012	.996	.923	1.028	.986	.917	.996	.991	.925	.961
.22	1.0	.000	.943		.000	.939		.000	.926		.000	.928	
.40	1.0	1.007	.946		1.003	.939		.989	.930		.988	.930	
.58	1.0	1.000	.942		.994	.936		.980	.926		.977	.926	
.76	1.0	.980	.951	.962	.973	.946	.961	.961	.938	.954	.959	.934	.937
.94	1.0	.933	.952		.949	.944		.915	.938		.918	.941	
1.12	1.0	.983	.979	.916	.975	.976	.914	.966	.960	.908	.964	.960	.898
1.30	1.0	1.013	.993		1.014	.991		.999	.979		.996	.976	
1.48	1.0	.967	.972		.958	.968		.956	.959		.955	.957	
1.64	1.0	1.004			1.001			.987			.984		
2.20	1.0	1.002	.988	.722	.998	.984	.726	.987	.975	.712	.983	.975	.705
2.56	1.0	.943			.933			.931			.929		
2.92	1.0	.980	.994		.972	.991		.965	.977		.960	.962	
3.28	1.0	1.006			.998			.990			.983		



TABLE B-1. (Continued)

(A) CONTINUED.												
X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 1, RUN 342/0			TEST 1, RUN 360/0			TEST 1, RUN 310/0			TEST 1, RUN 343/0		
0 .52	1.070	1.039		1.071	1.033		1.316	1.236		1.198	1.190	
0 .84	.970	.993	.980	.963	.979	.982	1.166	1.139	1.200	1.094	1.132	1.092
.03 1.0	1.003	.933	1.013	.997	.929	1.027	1.002	.932	.981	1.013	.960	1.017
.22 1.0	.000	.943		.000	.941		.000	.926		.000	.944	
.40 1.0	1.009	.946		1.003	.942		.987	.930		1.010	.948	
.58 1.0	.999	.942		.995	.940		.978	.924		1.003	.943	
.76 1.0	.977	.951	.962	.976	.948	.962	.958	.933	.934	.982	.950	.963
.94 1.0	.933	.953		.957	.948		.917	.939		.940	.953	
1.12 1.0	.982	.979	.916	.977	.976	.913	.962	.960	.897	.984	.980	.916
1.30 1.0	1.014	.993		1.012	.991		.996	.976		1.015	.996	
1.48 1.0	.967	.973		.963	.971		.955	.957		.970	.975	
1.84 1.0	1.005			1.001			.985			1.005		
2.20 1.0	1.004	.988	.723	.998	.985	.724	.983	.975	.704	1.002	.991	.723
2.56 1.0	.943			.940			.926			.945		
2.92 1.0	.979	.995		.975	.994		.958	.963		.980	.994	
3.28 1.0	1.006			.998			.983			1.005		
	TEST 1, RUN 381/0			TEST 1, RUN 311/0			TEST 1, RUN 377/2			TEST 1, RUN 336/0		
0 .52	1.133	1.102		1.310	1.347		1.133	1.108		1.365	1.429	
0 .84	1.022	1.046	1.035	1.212	1.242	1.195	1.022	1.037	1.029	1.356	1.453	1.338
.03 1.0	1.006	.941	1.034	1.022	.957	.987	.991	.926	1.019	1.097	1.168	1.122
.22 1.0	.000	.944		.000	.931		.000	.934		.000	.872	
.40 1.0	1.008	.948		.995	.935		.994	.936		.935	.871	
.58 1.0	1.000	.942		.985	.929		.986	.933		.936	.863	
.76 1.0	.978	.952	.988	.966	.938	.938	.967	.930	.950	.930	.867	.932
.94 1.0	.962	.953		.925	.943		.948	.940		.889	.876	
1.12 1.0	.979	.981	.920	.968	.966	.899	.972	.978	.908	.930	.899	.895
1.30 1.0	1.014	.996		1.001	.980		1.007	.991		.952	.921	
1.48 1.0	.965	.975		.960	.962		.960	.968		.923	.909	
1.84 1.0	1.004			.990			.994			.942		
2.20 1.0	1.002	.989	.727	.987	.980	.706	.990	.984	.725	.949	.944	.788
2.56 1.0	.940			.930			.934			.924		
2.92 1.0	1.976	.997		.963	.966		.972	.967		.946	.964	
3.28 1.0	1.001			.967			.993			.970		



TABLE B-1. (Continued)

(A) CONTINUED.													
X/D R/R		$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
		TEST 1, RUN 215/0			TEST 1, RUN 155/0			TEST 1, RUN 154/0			TEST 1, RUN 195/0		
0	.52	.910	.897		.778	.785		.776	.785		.771	.776	
0	.84	.940	.914	.901	.776	.783	.782	.775	.782	.781	.767	.774	.776
.03	1.0	.944	.934	.921	.852	.860	.856	.852	.859	.855	.842	.855	.852
.22	1.0	.968	.966		.939	.939		.937	.939		.935	.938	
.40	1.0	.981	.978		.965	.961		.965	.962		.963	.959	
.58	1.0	.989	.988		.978	.976		.977	.978		.973	.973	
.76	1.0	.000	.995	1.022	.000	.987	1.014	.000	.987	1.015	.000	.983	1.010
.94	1.0	1.016	1.007		1.007	1.003		1.007	1.002		1.000	.998	
1.12	1.0	.977	.988	1.021	.975	.986	1.015	.974	.984	1.015	.971	.982	1.013
1.30	1.0	.984	.986		.961	.000		.961	.000		.979	.000	
1.48	1.0	.977	.978		.974	.977		.974	.976		.970	.969	
1.84	1.0	.973			.974			.974			.966		
2.20	1.0	.969	.959	1.038	.971	.963	1.042	.970	.963	1.040	.965	.949	1.035
2.56	1.0	.962			.966			.964			.956		
2.92	1.0	.966	.966		.969	.969		.968	.968		.967	.961	
3.28	1.0	.977			.978			.977			.975		
		TEST 1, RUN 194/0			TEST 1, RUN 115/0			TEST 1, RUN 193/0			TEST 1, RUN 156/0		
0	.52	.769	.777		.774	.783		.826	.833		.830	.838	
0	.84	.768	.772	.773	.775	.780	.781	.822	.823	.828	.827	.833	.834
.03	1.0	.850	.859	.856	.852	.861	.858	.872	.883	.876	.874	.883	.880
.22	1.0	.939	.942		.939	.942		.945	.948		.947	.948	
.40	1.0	.966	.964		.966	.964		.968	.966		.970	.965	
.58	1.0	.979	.978		.979	.979		.979	.980		.980	.980	
.76	1.0	.000	.987	1.015	.967	.988	1.015	.000	.989	1.014	.000	.988	1.016
.94	1.0	1.007	1.002		1.011	1.003		1.007	1.003		1.008	1.003	
1.12	1.0	.974	.986	1.014	.974	.984	1.016	.974	.988	1.015	.977	.987	1.015
1.30	1.0	.982	.000		.962	.985		.982	.000		.984	.000	
1.48	1.0	.975	.977		.975	.977		.975	.977		.976	.978	
1.84	1.0	.973			.974			.973			.975		
2.20	1.0	.970	.958	1.041	.968	.961	1.682	.970	.961	1.041	.972	.965	1.042
2.56	1.0	.962			.963			.964			.966		
2.92	1.0	.972	.967		.968	.966		.975	.969		.972	.970	
3.28	1.0	.980			.978			.979			.979		

TABLE B-1. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
		TEST 1, RUN 196/0			TEST 1, RUN 116/0			TEST 1, RUN 153/0			TEST 1, RUN 152/0		
0	.52	.826	.831		.824	.829		.843	.852		.889	.903	
0	.84	.821	.822	.828	.821	.826	.828	.842	.847	.848	.889	.896	.894
.03	1.0	.865	.879	.875	.873	.882	.879	.880	.890	.888	.911	.922	.922
.22	1.0	.943	.946		.948	.951		.947	.949		.952	.964	
.40	1.0	.967	.965		.973	.970		.970	.967		.980	.981	
.58	1.0	.977	.979		.984	.983		.981	.980		.992	.992	
.76	1.0	.000	.986	1.018	.991	.993	1.020	.000	.988	1.015	.000	.998	1.026
.94	1.0	1.002	1.002		1.015	1.009		1.007	1.004		1.016	1.012	
1.12	1.0	.974	.983	1.015	.979	.988	1.021	.975	.987	1.015	.983	.983	1.024
1.30	1.0	.979	.000		.986	.988		.982	.000		.987	.000	
1.48	1.0	.972	.970		.977	.980		.975	.978		.984	.987	
1.84	1.0	.968			.974			.973			.983		
2.20	1.0	.963	.949	1.033	.970	.959	1.038	.970	.962	1.041	.979	.972	1.048
2.56	1.0	.956			.965			.965			.972		
2.92	1.0	.964	.959		.970	.966		.968	.968		.973	.976	
3.28	1.0	.975			.979			.977			.985		
		TEST 1, RUN 117/0			TEST 1, RUN 197/0			TEST 1, RUN 157/0			TEST 1, RUN 192/0		
0	.52	.888	.896		.892	.902		.896	.906		.889	.892	
0	.84	.885	.893	.893	.887	.894	.894	.892	.900	.900	.886	.895	.899
.03	1.0	.910	.921	.917	.907	.921	.918	.916	.925	.922	.927	.980	.920
.22	1.0	.958	.962		.958	.961		.963	.963		.966	.975	
.40	1.0	.977	.976		.976	.974		.979	.976		.980	.980	
.58	1.0	.986	.985		.983	.986		.987	.987		.987	.986	
.76	1.0	.990	.994	1.019	.000	.991	1.023	.000	.993	1.021	.000	.994	1.020
.94	1.0	1.013	1.008		1.005	1.005		1.010	1.007		1.010	1.006	
1.12	1.0	.978	.987	1.018	.977	.986	1.018	.980	.991	1.019	.977	.990	1.019
1.30	1.0	.984	.987		.983	.000		.986	.000		.984	.000	
1.48	1.0	.977	.979		.974	.973		.978	.981		.976	.978	
1.84	1.0	.972			.972			.978			.971		
2.20	1.0	.969	.959	1.040	.968	.954	1.038	.974	.968	1.043	.970	.956	1.039
2.56	1.0	.964			.959			.968			.961		
2.92	1.0	.968	.964		.968	.964		.973	.972		.971	.968	
3.28	1.0	.977			.978			.980			.978		

TABLE B-1. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 199/0			TEST 1, RUN 151/0			TEST 1, RUN 118/0			TEST 1, RUN 191/0		
0	.52	.933	.943		.932	.941		.938	.948		.934	.941	
0	.84	.928	.935	.937	.928	.935	.935	.934	.941	.943	.929	.937	.939
.03	1.0	.938	.953	.950	.942	.950	.950	.947	.957	.954	.951	.995	.952
.22	1.0	.974	.978		.974	.977		.976	.979		.982	.977	
.40	1.0	.987	.984		.987	.986		.988	.986		.992	.995	
.58	1.0	.991	.992		.993	.993		.994	.992		.995	.996	
.76	1.0	.000	.997	1.029	.000	.999	1.026	.996	.998	1.024	.000	.999	1.028
.94	1.0	1.011	1.010		1.015	1.011		1.016	1.010		1.013	1.010	
1.12	1.0	.981	.990	1.021	.981	.993	1.022	.982	.991	1.020	.981	.994	1.022
1.30	1.0	.986	.000		.986	.000		.987	.990		.988	.000	
1.43	1.0	.976	.974		.980	.982		.978	.980		.979	.982	
1.84	1.0	.970			.976			.976			.973		
2.20	1.0	.968	.961	1.037	.972	.963	1.039	.970	.964	1.656	.970	.960	1.038
2.56	1.0	.958			.965			.966			.962		
2.92	1.0	.967	.964		.967	.969		.970	.966		.973	.968	
3.28	1.0	.977			.978			.977			.979		
		TEST 1, RUN 158/0			TEST 1, RUN 150/0			TEST 1, RUN 190/0			TEST 1, RUN 159/0		
0	.52	.944	.955		.968	.977		.974	.981		.976	.987	
0	.84	.940	.946	.946	.962	.969	.971	.968	.975	.978	.971	.978	.979
.03	1.0	.951	.961	.959	.970	.980	.977	.975	.994	.982	.978	.987	.985
.22	1.0	.979	.982		.989	.992		.994	.998		.994	.997	
.40	1.0	.991	.989		.998	.995		1.000	.998		1.001	.999	
.58	1.0	.997	.996		1.000	1.000		1.002	1.000		1.003	1.003	
.76	1.0	.000	1.000	1.029	.000	1.003	1.032	.000	1.004	1.033	.000	1.006	1.035
.94	1.0	1.015	1.013		1.017	1.015		1.016	1.013		1.017	1.018	
1.12	1.0	.985	.994	1.023	.984	.995	1.025	.985	.996	1.026	.987	.998	1.027
1.30	1.0	.990	.000		.990	.000		.990	.000		.992	.000	
1.48	1.0	.982	.985		.979	.983		.981	.984		.984	.987	
1.84	1.0	.979			.975			.976			.979		
2.20	1.0	.974	.967	1.043	.971	.962	1.039	.973	.962	1.041	.973	.966	1.041
2.56	1.0	.968			.964			.965			.966		
2.92	1.0	.972	.971		.968	.967		.974	.971		.972	.969	
3.28	1.0	.979			.977			.979			.980		

TABLE B-1. (Continued)

(A) CONTINUED.													
X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 119/0			TEST 1, RUN 199/0			TEST 1, RUN 216/0			TEST 1, RUN 145/0		
0	.52	.986	.996		.978	.988		.738	.739		.572	.570	
0	.84	.981	.989	.990	.973	.979	.982	.744	.748	.769	.558	.562	.567
.03	1.0	.984	.994	.992	.974	.987	.986	.901	.913	.912	.901	.911	.911
.22	1.0	1.000	1.003		.994	.999		.973	.980		.976	.986	
.40	1.0	1.006	1.005		1.001	.999		.993	.988		.994	.988	
.58	1.0	1.008	1.008		1.000	1.003		1.012	.976		1.011	.979	
.76	1.0	.000	1.011	1.039	.000	1.006	1.037	.000	1.006	1.029	.000	1.008	1.030
.94	1.0	1.027	1.019		1.015	1.016		1.050	1.035		1.053	1.034	
1.12	1.0	.989	1.000	1.032	.966	.992	1.026	1.007	1.023	.983	1.007	1.026	.988
1.30	1.0	.994	.998		.990	.000		1.008	1.012		1.011	1.015	
1.48	1.0	.986	.988		.980	.978		1.015	1.017		1.015	1.018	
1.64	1.0	.981			.974			.956			.953		
2.20	1.0	.974	.966	1.040	.970	.954	1.037	.968	.937	1.133	.973	.941	1.126
2.56	1.0	.966			.960			.985			.980		
2.92	1.0	.970	.969		.968	.965		.978	1.011		.979	1.011	
3.28	1.0	.980			.979			.983			.985		
		TEST 1, RUN 164/0			TEST 1, RUN 204/0			TEST 1, RUN 124/0			TEST 1, RUN 185/0		
0	.52	.584	.572		.575	.565		.588	.580		.585	.578	
0	.84	.564	.566	.571	.558	.562	.568	.571	.567	.582	.570	.572	.578
.03	1.0	.898	.912	.918	.886	.903	.909	.903	.919	.919	.901	.912	.913
.22	1.0	.977	.988		.969	.977		.979	.989		.973	.985	
.40	1.0	.995	.998		.980	.984		1.002	.997		.988	.992	
.58	1.0	1.018	.982		1.004	.975		1.022	.986		1.013	.981	
.76	1.0	.000	1.012	1.033	.000	.992	1.026	.000	1.014	1.037	.000	1.005	1.034
.94	1.0	1.048	1.042		1.035	1.029		1.057	1.043		1.047	1.039	
1.12	1.0	1.013	1.029	.991	1.003	1.023	.987	1.014	1.025	.994	1.008	1.027	.988
1.30	1.0	1.011	.000		1.005	.000		1.013	1.018		1.012	.000	
1.48	1.0	1.023	1.021		1.015	1.006		1.020	1.025		1.020	1.022	
1.64	1.0	.952			.949			.963			.958		
2.20	1.0	.973	.943	1.129	.962	.926	1.144	.973	.947	1.145	.970	.942	1.150
2.56	1.0	.988			.981			.997			.990		
2.92	1.0	.980	1.011		.975	.999		.982	1.018		.983	1.011	
3.28	1.0	.985			.975			.988			.983		



TABLE B-1. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
		TEST 1, RUN 123/0			TEST 1, RUN 203/0			TEST 1, RUN 103/0			TEST 1, RUN 146/0		
0	.52	.729	.722		.726	.715		.739	.727		.729	.725	
0	.84	.712	.712	.722	.705	.707	.717	.716	.717	.725	.712	.714	.721
.03	1.0	.910	.926	.921	.890	.906	.908	.902	.917	.917	1.250	.913	.912
.22	1.0	.986	.996		.970	.981		.977	.989		.972	.982	
.40	1.0	1.013	.997		.982	.987		.999	.997		.995	.990	
.58	1.0	1.023	.991		1.005	.976		1.016	.984		1.014	.977	
.76	1.0	.000	1.024	1.039	.000	.999	1.025	.000	1.016	1.032	.000	1.009	1.029
.94	1.0	1.061	1.043		1.041	1.031		1.052	1.042		1.054	1.034	
1.12	1.0	1.019	1.020	.998	1.002	1.019	.988	1.013	1.027	.996	1.007	1.019	.988
1.30	1.0	1.014	1.023		1.006	.000		1.013	.000		1.006	1.012	
1.48	1.0	1.019	1.030		1.015	1.007		1.024	1.022		1.019	1.020	
1.84	1.0	.960			.944			.955			.951		
2.20	1.0	.984	.948	1.135	.962	.926	1.136	.977	.943	2.765	.972	.939	2.766
2.56	1.0	.986			.976			.985			.982		
2.92	1.0	.989	1.015		.978	1.000		.985	1.014		.976	1.008	
3.28	1.0	.997			.976			.990			.981		
		TEST 1, RUN 186/0			TEST 1, RUN 162/0			TEST 1, RUN 147/0			TEST 1, RUN 122/0		
0	.52	.736	.727		.809	.799		.810	.803		.822	.816	
0	.84	.717	.717	.725	.737	.786	.799	.792	.793	.802	.806	.809	.816
.03	1.0	.904	.917	.912	.907	.919	.917	.912	.927	.911	.918	.935	.921
.22	1.0	.976	.989		.978	.985		.981	.987		.987	.997	
.40	1.0	1.004	.990		.988	.994		1.005	.976		1.013	.990	
.58	1.0	1.013	.986		1.013	.983		1.012	.984		1.020	.990	
.76	1.0	.000	1.016	1.031	.000	1.007	1.034	.000	1.019	1.023	.000	1.025	1.036
.94	1.0	1.044	1.039		1.047	1.036		1.051	1.033		1.063	1.042	
1.12	1.0	1.012	1.018	.991	1.009	1.032	.993	1.009	1.013	.992	1.020	1.020	.999
1.30	1.0	1.007	.000		1.014	.000		1.005	1.016		1.010	1.023	
1.48	1.0	1.012	1.022		1.025	1.020		1.007	1.018		1.013	1.028	
1.84	1.0	.953			.951			.955			.959		
2.20	1.0	.981	.943	1.137	.969	.945	1.132	.986	.943	1.122	.986	.948	1.131
2.56	1.0	.986			.989			.982			.986		
2.92	1.0	.982	1.007		.986	1.008		.979	1.002		.986	1.019	
3.28	1.0	.991			.980			.991			.995		



TABLE B-1. (Continued)

(A) CONTINUED.												
X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 1, RUN 202/0			TEST 1, RUN 187/0			TEST 1, RUN 161/0			TEST 1, RUN 201/0		
0 .52	.820	.811		.828	.810		.883	.879		.883	.873	
0 .84	.799	.801	.810	.805	.802	.814	.867	.868	.875	.862	.864	.872
.03 1.0	.901	.917	.909	.934	.931	.915	.924	.932	.924	.915	.928	.915
.22 1.0	.969	.981		.982	.994		.977	.982		.969	.982	
.40 1.0	.986	.986		1.004	.979		.983	.990		.989	.984	
.58 1.0	1.003	.979		1.015	.992		1.011	.982		1.001	.977	
.76 1.0	.000	1.003	1.026	.000	1.020	1.023	.000	1.002	1.032	.000	1.005	1.024
.94 1.0	1.046	1.033		1.042	1.037		1.044	1.033		1.045	1.031	
1.12 1.0	1.002	1.017	.991	1.006	1.017	.995	1.010	1.032	.997	1.002	1.019	.992
1.30 1.0	1.004	.000		1.008	.000		1.011	.000		1.004	.000	
1.48 1.0	1.010	1.006		1.010	1.018		1.022	1.018		1.013	1.010	
1.84 1.0	.942			.957			.956			.941		
2.20 1.0	.968	.930	1.136	.987	.945	1.124	.968	.943	1.133	.966	.932	1.134
2.56 1.0	.978			.986			.992			.977		
2.92 1.0	.979	1.000		.982	1.003		.982	1.004		.976	1.003	
3.28 1.0	.978			.997			.975			.978		
	TEST 1, RUN 148/0			TEST 1, RUN 121/0			TEST 1, RUN 168/0			TEST 1, RUN 120/0		
0 .52	.879	.874		.897	.892		.896	.884		.966	.963	
0 .84	.864	.863	.872	.882	.882	.890	.876	.874	.885	.952	.953	.961
.03 1.0	.921	.939	.916	.930	.947	.926	.931	.945	.920	.957	.967	.940
.22 1.0	.974	.981		.983	.994		.986	.994		.981	.990	
.40 1.0	.996	.988		1.010	.992		1.004	.976		.996	.995	
.58 1.0	1.010	.978		1.017	.991		1.016	.991		1.016	.984	
.76 1.0	.000	1.010	1.027	.000	1.024	1.035	.000	1.020	1.025	.000	1.013	1.036
.94 1.0	1.046	1.032		1.056	1.040		1.042	1.038		1.059	1.039	
1.12 1.0	1.008	1.018	.989	1.016	1.022	.995	1.009	1.019	.995	1.010	1.025	.993
1.30 1.0	1.005	1.011		1.010	1.022		1.007	.000		1.013	1.017	
1.48 1.0	1.014	1.019		1.019	1.029		1.007	1.016		1.022	1.022	
1.84 1.0	.951			.959			.957			.952		
2.20 1.0	.975	.940	1.124	.983	.946	1.131	.987	.947	1.126	.972	.942	1.142
2.56 1.0	.982			.981			.987			.984		
2.92 1.0	.977	1.005		.978	1.012		.984	1.004		.980	1.016	
3.28 1.0	.983			.988			.993			.979		

TABLE B-1. (Continued)

(A) CONTINUED.													
X/D	P/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 149/0			TEST 1, RUN 200/0			TEST 1, RUN 160/0			TEST 1, RUN 189/0		
0	.52	.940	.943		.951	.944		.953	.951		.962	.956	
0	.84	.933	.934	.939	.937	.934	.946	.940	.942	.946	.948	.944	.954
.03	1.0	.946	.952	.931	.943	.949	.935	.951	.957	.937	.956	.963	.940
.22	1.0	.972	.978		.973	.980		.979	.981		.980	.993	
.40	1.0	.985	.986		.980	.986		.984	.990		1.005	.991	
.52	1.0	1.009	.974		1.005	.976		1.010	.982		1.013	.987	
.76	1.0	.000	1.000	1.025	.000	1.001	1.022	.000	1.002	1.033	.000	1.018	1.030
.94	1.0	1.044	1.029		1.046	1.030		1.043	1.032		1.051	1.036	
1.12	1.0	1.005	1.020	.987	.999	1.023	.992	1.009	1.032	.995	1.009	1.018	.998
1.30	1.0	1.009	1.010		1.006	.000		1.011	.000		1.007	.000	
1.48	1.0	1.019	1.016		1.021	1.012		1.022	1.019		1.019	1.019	
1.84	1.0	.948			.941			.954			.954		
2.20	1.0	.966	.936	1.124	.964	.930	1.130	.964	.942	1.131	.979	.944	1.127
2.56	1.0	.982			.976			.993			.989		
2.92	1.0	.980	1.001		.977	.998		.981	1.003		.982	1.009	
3.28	1.0	.976			.972			.975			.988		
		TEST 1, RUN 205/0			TEST 1, RUN 165/0			TEST 1, RUN 125/0			TEST 1, RUN 206/0		
0	.52	.585	.584		.644	.652		.665	.685		.776	.773	
0	.84	.576	.579	.579	.633	.645	.638	.653	.687	.661	.754	.761	.762
.03	1.0	.936	.934	1.017	.958	.988	1.071	.958	.973	1.042	.967	.969	1.046
.22	1.0	.978	.968		1.020	1.023		1.013	1.014		1.007	.991	
.40	1.0	.931	.978		.963	1.024		.983	1.014		.964	1.021	
.58	1.0	.940	.988		.989	1.036		.984	1.025		.952	1.005	
.76	1.0	.000	.942	1.026	.000	1.013	1.065	.000	.978	1.059	.000	.965	1.059
.94	1.0	.904	.899		.929	.943		.917	.923		.928	.928	
1.12	1.0	.883	.904	1.102	.928	.943	1.133	.911	.937	1.145	.917	.937	1.150
1.30	1.0	.933	.000		.952	.000		.954	.944		.978	.000	
1.48	1.0	.933	.891		.959	.927		.965	.914		.957	.919	
1.84	1.0	.919			.970			.951			.944		
2.20	1.0	.919	.904	.932	.953	.945	.971	.948	.931	.965	.952	.937	.966
2.56	1.0	.950			.984			.985			.992		
2.92	1.0	.960	.967		.994	1.020		.992	.988		.994	.976	
3.28	1.0	.965			1.000			.987			1.002		

TABLE B-1. (Continued)

(A) CONTINUED.

X/D R/R		$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
		TEST 1, RUN 166/0			TEST 1, RUN 126/0			TEST 1, RUN 207/0			TEST 1, RUN 167/0		
0	.52	.781	.787		.796	.800		.845	.845		.888	.892	
0	.84	.769	.779	.773	.778	.789	.784	.820	.830	.826	.866	.875	.872
.03	1.0	.958	.987	1.066	.962	.960	1.047	.940	.938	1.017	.971	.971	1.060
.22	1.0	1.021	1.027		1.014	1.000		.971	.972		1.002	1.015	
.40	1.0	.991	1.021		.964	1.019		.943	.997		.977	1.044	
.58	1.0	.978	1.032		.985	1.021		.918	.971		.958	1.013	
.76	1.0	.000	1.004	1.066	.000	.972	1.058	.000	.939	1.031	.000	.978	1.067
.94	1.0	.931	.942		.917	.922		.902	.905		.930	.943	
1.12	1.0	.938	.940	1.129	.918	.939	1.151	.902	.918	1.119	.939	.948	1.165
1.30	1.0	.946	.000		.966	.940		.959	.000		.992	.000	
1.48	1.0	.968	.928		.967	.918		.918	.898		.958	.927	
1.84	1.0	.962			.949			.917			.949		
2.20	1.0	.954	.941	.974	.950	.931	.964	.932	.917	.939	.959	.945	.976
2.56	1.0	.979			.981			.956			.980		
2.92	1.0	1.000	1.014		.967	.991		.964	.947		.999	.984	
3.28	1.0	1.001			.992			.974			1.017		
		TEST 1, RUN 127/0			TEST 1, RUN 208/0			TEST 1, RUN 168/0			TEST 1, RUN 128/0		
0	.52	.896	.893		.937	.928		.978	.971		.980	.973	
0	.84	.867	.877	.875	.907	.908	.914	.948	.953	.955	.953	.957	.958
.03	1.0	.963	.969	1.042	.944	.948	1.013	.979	.987	1.052	.975	.981	1.050
.22	1.0	.993	1.013		.931	.990		.991	1.027		.985	1.013	
.40	1.0	.975	1.042		.947	.996		.980	1.050		.966	1.040	
.58	1.0	.949	1.000		.905	.955		.946	1.002		.943	.990	
.76	1.0	.000	.971	1.062	.000	.939	1.025	.000	.978	1.065	.000	.968	1.059
.94	1.0	.931	.944		.911	.907		.938	.958		.928	.948	
1.12	1.0	.943	.936	1.154	.931	.892	1.098	.956	.935	1.144	.947	.934	1.145
1.30	1.0	.989	.934		.935	.000		.990	.000		.986	.934	
1.48	1.0	.939	.926		.913	.898		.938	.934		.936	.928	
1.84	1.0	.938			.902			.934			.927		
2.20	1.0	.962	.939	.980	.933	.919	.945	.964	.942	.981	.957	.933	.976
2.56	1.0	.971			.924			.969			.959		
2.92	1.0	.998	.976		.959	.947		1.003	.981		.997	.970	
3.28	1.0	1.011			.984			1.016			1.011		

TABLE B-1. (Continued)

(A) CONTINUED.													
X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 209/0			TEST 1, RUN 129/0			TEST 1, RUN 169/0			TEST 1, RUN 218/0		
0	.52	.998	.989		1.024	1.015		1.028	1.023		.177	.180	
0	.84	.968	.968	.973	.995	.997	.997	1.000	1.003	1.005	.182	.221	.209
.03	1.0	.965	.969	1.008	.987	1.004	1.022	.995	1.007	1.052	1.070	.927	.961
.22	1.0	.926	.992		.977	1.036		.982	1.038		.993	.938	
.40	1.0	.944	.990		.977	1.029		.986	1.052		.997	.936	
.58	1.0	.907	.955		.943	.989		.951	1.004		.995	.941	
.76	1.0	.000	.937	1.023	.000	.971	1.060	.000	.980	1.069	.000	.944	.939
.94	1.0	.916	.897		.939	.940		.944	.958		.946	.927	
1.12	1.0	.931	.889	1.089	.957	.924	1.134	.968	.932	1.146	.976	.973	.902
1.30	1.0	.930	.000		.964	.935		.979	.000		1.001	.992	
1.48	1.0	.915	.892		.931	.925		.946	.939		.966	.979	
1.84	1.0	.902			.922			.937			.995		
2.20	1.0	.935	.922	4.596	.955	.936	.984	.970	.948	.986	.995	.990	.713
2.56	1.0	.919			.944			.958			.948		
2.92	1.0	.942	.944		.995	.974		1.004	.985		.976	.974	
3.28	1.0	.985			1.014			1.022			.990		
		TEST 1, RUN 134/0			TEST 1, RUN 210/0			TEST 1, RUN 133/0			TEST 1, RUN 211/0		
0	.52	.000	.577		.628	.602		.000	.746		.784	.750	
0	.84	.558	.568	.574	.585	.585	.604	.718	.722	.730	.725	.726	.740
.03	1.0	.994	.939	.994	.966	.926	.985	.993	.941	1.000	.964	.925	.987
.22	1.0	1.009	.000		.992	.935		1.006	.000		.990	.936	
.40	1.0	1.012	.951		.998	.933		1.010	.951		.998	.933	
.58	1.0	.000	.957		1.012	.939		.000	.958		1.021	.940	
.76	1.0	.000	.959	.966	.000	.941	.944	.000	.958	.969	.000	.940	.942
.94	1.0	.000	.943		.973	.924		.000	.943		.991	.926	
1.12	1.0	.985	.990	.926	.974	.976	.902	.985	.988	.928	.977	.980	.898
1.30	1.0	1.016	1.009		1.002	.000		1.012	1.008		1.002	.000	
1.48	1.0	.976	.991		.960	.979		.973	.990		.965	.984	
1.84	1.0	1.009			.992			1.005			.994		
2.20	1.0	1.007	.997	.740	.993	.987	.720	1.004	.998	.743	.992	.989	.723
2.56	1.0	.960			.943			.957			.947		
2.92	1.0	.992	.985		.972	.973		.987	.986		.973	.975	
3.28	1.0	1.002			.964			1.000			.984		



TABLE B-1. (Continued)

(A) CONTINUED.													
X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 132/0			TEST 1, RUN 212/2			TEST 1, RUN 131/0			TEST 1, RUN 213/0		
0	.52	.000	.861		.924	.904		.000	.949		.973	.943	
0	.84	.822	.823	.830	.869	.874	.876	.907	.903	.915	.911	.899	.909
.03	1.0	.997	.943	.998	.954	.924	.994	.994	.943	1.001	.979	.929	.993
.22	1.0	1.007	.000		.993	.935		1.002	.000		.991	.938	
.40	1.0	1.013	.952		.997	.935		1.008	.951		.998	.935	
.58	1.0	.000	.958		1.000	.942		.000	.957		1.027	.942	
.76	1.0	.000	.960	.970	.000	.944	.940	.000	.956	.968	.000	.941	.947
.94	1.0	.000	.945		1.027	.932		.000	.940		.995	.923	
1.12	1.0	.986	.990	.928	.987	.976	.888	.983	.989	.926	.974	.985	.899
1.30	1.0	1.018	1.011		1.006	.000		1.010	1.009		1.004	.000	
1.48	1.0	.976	.993		.964	.991		.972	.992		.964	.986	
1.84	1.0	1.011			1.002			1.007			.995		
2.20	1.0	1.009	1.002	.741	.996	.998	.702	1.002	.999	.743	.991	.992	.723
2.56	1.0	.962			.971			.954			.943		
2.92	1.0	.988	.988		.984	.980		.985	.987		.975	.980	
3.28	1.0	1.001			.989			1.001			.985		
		TEST 1, RUN 214/0			TEST 1, RUN 130/0			TEST 1, RUN 709/0			TEST 1, RUN 702/0		
0	.52	1.035	1.003		.000	1.036		.000	.000		.000	.000	
0	.84	.967	.952	.967	.990	.984	.996	.939	.876	.891	.928	.877	.882
.03	1.0	.985	.936	.995	.994	.943	.996	.971	.935	1.040	.968	.933	1.012
.22	1.0	.996	.940		1.002	.000		.979	.940		.972	.936	
.40	1.0	1.003	.938		1.007	.948		.983	.949		.977	.947	
.58	1.0	1.031	.945		.000	.954		.979	.957		.974	.954	
.76	1.0	.000	.943	.953	.000	.954	.963	.983	.962	3.823	.977	.960	.984
.94	1.0	1.000	.927		.000	.940		.955	.961		.952	.957	
1.12	1.0	.980	.991	.907	.983	.967	.922	.983	.986	.923	.976	.981	.919
1.30	1.0	1.010	.000		1.012	1.007		1.018	.994		1.014	.990	
1.48	1.0	.969	.991		.973	.990		.970	.944		.963	.940	
1.84	1.0	1.001			1.006			1.011			1.006		
2.20	1.0	.997	.995	.729	1.003	.996	.739	1.008	.976	.726	1.005	.972	.725
2.56	1.0	.945			.955			.961			.951		
2.92	1.0	.977	.982		.983	.985		.981	.992		.979	.987	
3.28	1.0	.990			.997			1.009			1.010		



TABLE B-1. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 712/0			TEST 1, RUN 708/0			TEST 1, RUN 710/0			TEST 1, RUN 703/0		
0	.52	.000	.000		.000	.000		.000	.000		.000	.000	
0	.84	.983	.943	.954	1.146	1.096	1.111	1.363	1.194	1.288	1.204	1.171	1.178
.03	1.0	.979	.924	1.005	.997	.968	1.047	1.093	.996	1.030	1.012	.985	1.015
.22	1.0	.971	.924		.977	.936		.965	.921		.971	.928	
.40	1.0	.978	.940		.982	.952		.973	.940		.978	.950	
.58	1.0	.973	.948		.979	.954		.970	.940		.973	.951	
.76	1.0	.978	.952	3.821	.980	.958	3.822	.972	.945	2.829	.977	.955	.983
.94	1.0	.946	.950		.954	.957		.958	.942		.951	.952	
1.12	1.0	.971	.975	.908	.980	.984	.918	.975	.981	.892	.976	.981	.918
1.30	1.0	1.010	.985		1.017	.993		1.010	.990		1.015	.990	
1.48	1.0	.950	.933		.969	.944		.962	.940		.962	.939	
1.84	1.0	1.001			1.011			1.001			1.006		
2.20	1.0	.999	.968	.710	1.007	.977	.719	.995	.970	.693	1.004	.973	.719
2.56	1.0	.940			.960			.949			.950		
2.92	1.0	.972	.982		.982	.993		.971	.988		.979	.989	
3.28	1.0	1.001			1.008			.995			1.009		
		TEST 1, RUN 701/0			TEST 1, RUN 704/0			TEST 1, RUN 715/0			TEST 1, RUN 707/0		
0	.52	.000	.000		.000	.000		.000	.000		.000	.000	
0	.84	1.361	1.318	1.341	1.401	1.379	1.373	1.569	1.485	1.499	1.417	1.381	1.388
.03	1.0	1.061	1.021	1.001	1.093	1.086	1.020	1.210	1.163	1.086	1.120	1.105	1.052
.22	1.0	.961	.908		.969	.915		.969	.923		.973	.925	
.40	1.0	.970	.941		.976	.957		.981	.956		.981	.961	
.58	1.0	.968	.941		.972	.948		.976	.944		.977	.951	
.76	1.0	.973	.947	3.821	.976	.951	.981	.977	.949	3.822	.980	.956	3.753
.94	1.0	.943	.944		.949	.948		.961	.942		.959	.950	
1.12	1.0	.968	.968	.903	.974	.977	.915	.978	.984	.896	.980	.981	.919
1.30	1.0	1.005	.980		1.014	.989		1.016	.997		1.017	.992	
1.48	1.0	.947	.928		.960	.938		.965	.944		.966	.942	
1.84	1.0	.996			1.006			1.006			1.007		
2.20	1.0	.995	.963	.700	1.002	.972	.712	1.002	.977	.693	1.004	.976	.716
2.56	1.0	.938			.948			.952			.950		
2.92	1.0	.967	.980		.979	.967		.977	.995		.977	.994	
3.28	1.0	.998			1.010			1.000			1.007		

TABLE B-1. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 713/0			TEST 1, RUN 714/0			TEST 1, RUN 706/0			TEST 1, RUN 711/0		
0	.52	.000	.000		.000	.000		.000	.000		.000	.000	
0	.84	1.673	1.615	1.655	1.717	1.815	1.597	1.670	1.651	1.637	1.765	1.510	1.625
.03	1.0	1.227	1.202	1.033	1.321	1.511	1.059	1.241	1.223	1.111	1.324	1.197	1.118
.22	1.0	.962	.893		.968	.897		.971	.921		.971	.924	
.40	1.0	.975	.951		.978	.958		.962	.968		.986	.956	
.58	1.0	.970	.942		.975	.942		.976	.950		.978	.943	
.76	1.0	.973	.946	3.812	.960	.944	3.821	.980	.954	1.053	.980	.944	3.822
.94	1.0	.940	.940		.951	.939		.963	.945		.961	.928	
1.12	1.0	.965	.968	.901	.973	.972	.905	.977	.981	.917	.973	.991	.894
1.30	1.0	1.010	.982		1.011	.985		1.018	.992		1.021	1.000	
1.48	1.0	.947	.928		.951	.932		.965	.941		.958	.943	
1.84	1.0	1.000			1.003			1.008			1.008		
2.20	1.0	.998	.966	.691	1.002	.971	.689	1.005	.977	.711	1.000	.979	.687
2.56	1.0	.935			.942			.948			.933		
2.92	1.0	.972	.982		.973	.987		.979	.996		.975	.993	
3.28	1.0	.999			1.005			1.007			1.002		
		TEST 1, RUN 705/0			TEST 1, RUN 551/0			TEST 1, RUN 542/0			TEST 1, RUN 541/0		
0	.52	.000	.000		.924	.906		.822	.824		.829	.845	
0	.84	1.554	1.533	1.508	.937	.000	.907	.823	.000	.818	.827	.000	.830
.03	1.0	3.821	1.182	1.042	.944	.000	.933	.871	.000	.882	.876	.000	.862
.22	1.0	.972	.910		.969	.964		.943	.942		.940	.938	
.40	1.0	.980	.968		.980	.979		.966	.967		.962	.962	
.58	1.0	.976	.948		.986	.986		.977	.976		.972	.981	
.76	1.0	.980	.952	.983	.991	.991	1.019	.982	.986	1.011	.987	.988	1.016
.94	1.0	.954	.945		1.003	1.001		.996	.994		.999	.998	
1.12	1.0	.977	.980	.918	.963	.995	1.030	.977	.991	1.027	.981	.986	1.030
1.30	1.0	1.017	.991		.988	.993		.985	.990		.980	.985	
1.48	1.0	.963	.941		.975	.976		.971	.971		.967	.967	
1.84	1.0	1.009			.973			.968			.975		
2.20	1.0	1.006	.978	.708	.967	.958	1.050	.964	.953	1.048	.970	.963	1.051
2.56	1.0	.948			.961			.958			.965		
2.92	1.0	.980	.991		.969	.967		.967	.966		.961	.971	
3.28	1.0	1.014			.984			.981			.975		

TABLE B-1. (Continued)

(A) CONTINUED.												
X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 1, RUN 519/0			TEST 1, RUN 540/0			TEST 1, RUN 550/0			TEST 1, RUN 518/0		
0 .52	.860	.870		.871	.876		.892	.896		.965	.871	
0 .84	.857	.000	.862	.867	.000	.874	.887	.000	.897	.864	.000	.869
.03 1.0	.893	.000	.904	.896	.000	.909	.909	.000	.923	.895	.000	.908
.22 1.0	.951	.950		.955	.951		.963	.963		.954	.951	
.40 1.0	.971	.972		.972	.972		.979	.979		.972	.973	
.58 1.0	.981	.982		.980	.981		.985	.988		.982	.981	
.76 1.0	.988	.990	1.017	.987	.987	1.016	.992	.992	1.021	.986	.991	1.017
.94 1.0	1.001	1.000		.999	.997		1.002	1.001		1.003	1.000	
1.12 1.0	.983	.993	1.031	.979	.991	1.029	.980	.997	1.028	.982	.995	1.032
1.30 1.0	.985	.991		.984	.989		.991	.997		.985	.991	
1.48 1.0	.972	.972		.970	.970		.975	.977		.973	.974	
1.64 1.0	.000			.968			.974			.000		
2.20 1.0	.967	.955	1.048	.961	.951	1.042	.967	.962	1.043	.966	.950	1.046
2.56 1.0	.961			.955			.961			.958		
2.92 1.0	.966	.968		.964	.961		.975	.969		.965	.967	
3.28 1.0	.983			.980			.985			.984		
	TEST 1, RUN 539/0			TEST 1, RUN 538/0			TEST 1, RUN 552/0			TEST 1, RUN 533/0		
0 .52	.917	.926		.947	.960		.749	.751		.580	.576	
0 .84	.913	.000	.924	.944	.000	.953	.753	.000	.779	.568	.000	.579
.03 1.0	.931	.000	.944	.954	.000	.968	.902	.000	.921	.902	.000	.917
.22 1.0	.969	.969		.980	.982		.978	.984		.976	.978	
.40 1.0	.983	.984		.990	.994		.986	1.002		.984	.996	
.58 1.0	.989	.989		.995	.997		1.010	.988		1.002	.981	
.76 1.0	.992	.995	1.022	.996	1.002	1.026	1.011	1.008	1.032	1.005	1.000	1.022
.94 1.0	1.006	1.004		1.010	1.009		1.053	1.044		1.049	1.036	
1.12 1.0	.983	.994	1.035	.985	.997	1.037	1.011	1.041	1.011	1.005	1.033	1.015
1.30 1.0	.988	.992		.990	.994		1.016	1.025		1.008	1.019	
1.48 1.0	.974	.973		.976	.976		1.013	1.010		1.012	1.000	
1.64 1.0	.970			.972			.952			.932		
2.20 1.0	.965	.952	1.042	.968	.955	1.045	.963	.931	1.150	.953	.919	1.140
2.56 1.0	.957			.959			.976			.972		
2.92 1.0	.966	.964		.967	.967		.983	1.008		.977	1.000	
3.28 1.0	.983			.984			.987			.980		

TABLE B-1. (Continued)

(A) CONTINUED.

X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 1, RUN 534/0			TEST 1, RUN 535/0			TEST 1, RUN 520/0			TEST 1, RUN 517/0		
0 .52	.687	.679		.689	.678		.741	.732		.745	.735	
0 .84	.667	.000	.678	.671	.000	.679	.722	.000	.728	.725	.000	.730
.03 1.0	.902	.000	.910	.902	.000	.910	.907	.000	.917	.919	.000	.917
.22 1.0	.978	.984		.980	.987		.982	.990		.990	.990	
.40 1.0	1.000	.989		1.004	.987		1.006	.997		1.004	.977	
.58 1.0	1.002	.985		1.003	.986		1.007	.988		1.016	1.001	
.76 1.0	1.011	1.017	1.026	1.017	1.016	1.021	1.020	1.021	1.026	1.033	1.028	1.017
.94 1.0	1.052	1.037		1.050	1.038		1.059	1.037		1.052	1.040	
1.12 1.0	1.008	1.026	1.015	1.009	1.020	1.014	1.005	1.026	1.015	1.003	1.022	1.015
1.30 1.0	1.002	1.015		1.003	1.017		1.007	1.021		1.000	1.033	
1.48 1.0	.998	1.001		.999	1.000		1.005	1.005		.988	.996	
1.84 1.0	.937			.940			.000			.000		
2.20 1.0	.966	.924	1.136	.970	.926	1.135	.969	.925	1.135	.982	.933	1.139
2.56 1.0	.973			.972			.972			.972		
2.92 1.0	.973	1.000		.976	.997		.977	1.008		.985	.995	
3.28 1.0	.992			.995			.996			1.001		
	TEST 1, RUN 549/0			TEST 1, RUN 536/0			TEST 1, RUN 537/0			TEST 1, RUN 553/0		
0 .52	.795	.785		.830	.820		.888	.882		.705	.709	
0 .84	.772	.000	.780	.807	.000	.816	.868	.000	.873	.710	.000	.749
.03 1.0	.916	.000	.924	.910	.000	.918	.930	.000	.924	.954	.000	1.063
.22 1.0	.990	1.000		.974	.984		.982	.996		1.008	1.011	
.40 1.0	1.008	1.000		.998	.997		1.006	1.001		1.013	1.017	
.58 1.0	1.013	.998		1.003	.981		1.006	.994		.961	1.007	
.76 1.0	1.025	1.027	1.033	1.012	1.012	1.021	1.020	1.023	1.022	.959	1.005	1.061
.94 1.0	1.057	1.046		1.052	1.037		1.048	1.041		.930	.952	
1.12 1.0	1.011	1.026	1.022	1.005	1.022	1.014	1.003	1.020	1.017	.935	.928	1.128
1.30 1.0	1.014	1.029		1.005	1.015		1.006	1.019		.935	.942	
1.48 1.0	1.010	1.008		1.008	1.000		1.003	1.000		.932	.906	
1.84 1.0	.947			.934			.938			.961		
2.20 1.0	.978	.936	1.138	.964	.920	1.137	.973	.924	1.134	.941	.933	.990
2.56 1.0	.980			.972			.972			.951		
2.92 1.0	.980	1.013		.971	1.001		.974	1.003		.997	1.007	
3.28 1.0	1.000			.985			.992			1.001		



TABLE B-1. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 532/0			TEST 1, RUN 531/0			TEST 1, RUN 516/0			TEST 1, RUN 521/0		
0	.52	.613	.623		.739	.735		.783	.784		.796	.795	
0	.84	.600	.000	.612	.718	.000	.730	.753	.000	.764	.769	.000	.778
.03	1.0	.946	.000	1.044	.954	.000	1.074	.968	.000	1.068	.969	.000	1.059
.22	1.0	.991	1.016		1.016	1.022		1.026	1.013		1.012	1.003	
.40	1.0	1.007	1.016		.996	1.030		.972	1.019		.958	1.020	
.58	1.0	.967	1.013		.969	1.030		.962	1.026		.956	1.029	
.76	1.0	.970	1.004	1.069	.932	.997	1.073	.936	.985	1.073	.937	.973	1.072
.94	1.0	.967	.984		.944	.943		.946	.933		.936	.932	
1.12	1.0	.938	.957	1.128	.912	.945	1.129	.911	.951	1.140	.910	.952	1.151
1.30	1.0	.938	.937		.953	.954		.957	.952		.970	.941	
1.48	1.0	.936	.911		.944	.910		.957	.903		.952	.906	
1.64	1.0	.955			.945			.000			.000		
2.20	1.0	.950	.923	.996	.940	.916	.975	.946	.926	.979	.945	.924	.978
2.56	1.0	.931			.975			.982			.983		
2.92	1.0	.986	1.005		1.000	1.005		.997	1.013		.992	1.000	
3.28	1.0	1.033			1.010			1.006			1.005		
		TEST 1, RUN 530/0			TEST 1, RUN 548/0			TEST 1, RUN 529/0			TEST 1, RUN 528/0		
0	.52	.816	.817		.854	.849		.893	.892		.942	.941	
0	.84	.788	.000	.796	.829	.000	.829	.869	.000	.867	.920	.000	.910
.03	1.0	.967	.000	1.063	.971	.000	1.066	.964	.000	1.066	.975	.000	1.065
.22	1.0	1.015	1.008		1.006	1.002		.985	1.025		.980	1.028	
.40	1.0	.957	1.033		.977	1.037		.982	1.054		.983	1.054	
.58	1.0	.947	1.036		.940	.999		.926	1.005		.926	1.002	
.76	1.0	.938	.990	1.081	.926	.968	1.077	.948	.985	1.072	.949	.984	1.070
.94	1.0	.946	.951		.942	.937		.954	.964		.957	.963	
1.12	1.0	.918	.952	1.148	.934	.959	1.159	.953	.942	1.158	.959	.939	1.155
1.30	1.0	.983	.937		.993	.941		.984	.936		.974	.939	
1.48	1.0	.957	.906		.951	.914		.938	.916		.938	.920	
1.64	1.0	.951			.937			.930			.926		
2.20	1.0	.952	.932	.973	.956	.938	.974	.964	.936	.982	.962	.936	.989
2.56	1.0	.988			.978			.956			.949		
2.92	1.0	.997	.997		.996	.977		.996	.971		.986	.977	
3.28	1.0	1.009			1.019			1.024			1.028		



TABLE B-1. (Continued)

(A) CONTINUED.													
X/D R/R		$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 554/0			TEST 1, RUN 523/1			TEST 1, RUN 524/0			TEST 1, RUN 522/0		
0	.52	.257	.392		.497	.562		.668	.705		.717	.756	
0	.84	.262	.000	.308	.478	.000	.487	.640	.000	.640	.677	.000	.678
.03	1.0	.973	.000	.987	.972	.000	1.000	.971	.000	1.009	.975	.000	1.001
.22	1.0	.998	.952		.996	.951		.997	.951		.998	.951	
.40	1.0	1.001	.959		.999	.958		.998	.958		.997	.961	
.58	1.0	.996	.962		.995	.964		.995	.962		.994	.965	
.76	1.0	1.003	.972	.902	1.004	.972	.978	1.003	.970	.977	1.003	.973	.980
.94	1.0	.989	.971		.993	.959		.995	.969		.993	.972	
1.12	1.0	.988	.987	.926	.957	.994	.925	.991	.993	.919	.989	.993	.927
1.30	1.0	1.019	.998		1.020	1.003		1.021	1.002		1.020	1.003	
1.48	1.0	.966	.973		.967	.978		.971	.978		.966	.979	
1.84	1.0	1.006			.000			.000			.000		
2.20	1.0	1.006	.986	.725	1.007	.990	3.820	1.006	.990	.716	1.007	.991	.726
2.56	1.0	.959			.879			.958			.956		
2.92	1.0	.994	.989		.992	.991		.990	.993		.990	.993	
3.28	1.0	1.026			1.024			1.023			1.023		
		TEST 1, RUN 515/0			TEST 1, RUN 546/0			TEST 1, RUN 547/0			TEST 1, RUN 525/0		
0	.52	.700	.757		.769	.814		.833	.870		.773	.805	
0	.84	.661	.000	.662	.747	.000	.749	.792	.000	.796	.728	.000	.734
.03	1.0	.975	.000	1.000	.972	.000	1.007	.971	.000	1.021	.974	.000	1.008
.22	1.0	.999	.952		.998	.952		.996	.950		.998	.950	
.40	1.0	.999	.961		.999	.958		.996	.958		.998	.957	
.58	1.0	.996	.965		.994	.962		.992	.961		.993	.960	
.76	1.0	1.004	.975	.987	1.005	.971	.975	1.003	.970	.978	1.002	.970	.977
.94	1.0	.992	.972		.997	.968		.994	.965		.994	.968	
1.12	1.0	.992	.992	.930	.991	.995	.919	.997	1.003	.915	.989	.992	.923
1.30	1.0	1.020	1.002		1.024	1.005		1.027	1.012		1.021	1.003	
1.48	1.0	.968	.979		.971	.979		.973	.986		.967	.977	
1.84	1.0	.000			.000			.000			.000		
2.20	1.0	1.006	.992	.729	1.007	.990	.717	1.006	.993	.711	1.006	.989	.720
2.56	1.0	.960			.957			.958			.956		
2.92	1.0	.992	.992		.991	.992		.995	.990		.990	.992	
3.28	1.0	1.024			1.024			1.028			1.022		

TABLE B-1. (Continued)

(A) CONCLUDED.													
X/D	R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
		TEST 1, RUN 526/0			TEST 1, RUN 527/0								
0	.52	.863	.878		.914	.926							
0	.84	.810	.000	.816	.851	.000	.858						
.03	1.0	.979	.000	1.015	.980	.000	1.011						
.22	1.0	1.004	.958		1.005	.956							
.40	1.0	1.005	.965		1.005	.964							
.58	1.0	1.001	.966		1.001	.966							
.76	1.0	1.010	.977	.984	1.008	.975	.983						
.94	1.0	1.003	.974		1.003	.973							
1.12	1.0	.998	.998	.925	.997	.998	.926						
1.30	1.0	1.026	1.006		1.027	1.008							
1.48	1.0	.977	.983		.973	.982							
1.84	1.0	.000			.000								
2.20	1.0	1.012	.994	.721	1.011	.993	.721						
2.56	1.0	.966			.963								
2.92	1.0	.997	.996		.994	.996							
3.28	1.0	1.028			1.026								

TABLE B-1. (Continued)

(B) E1A2

X/D R/R	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$
	TEST 2		TEST 2		TEST 2		TEST 2		TEST 2		TEST 2	
0 .52		.519		.000		.655		.774		.785		.000
0 .84	.511	.517	.624	.703	.648	.651	.763	.762	.764	.762	.282	.280
.03 1.0	.904	RUN	.908	RUN	.893	RUN	.904	RUN	.908	RUN	.965	RUN
.33 1.0	.957	32/0	.950	133/0	.953	33/0	.969	35/0	.954	34/0	1.054	49/0
.67 1.0	.951		.000		.921		.906		.925		.000	
	TEST 2		TEST 2		TEST 2		TEST 2		TEST 2		TEST 2	
0 .52		.000		.000		.000		.000		.000		.000
0 .84	.313	.000	.281	.000	.435	.481	.505	.000	.708	.731	.812	.769
.03 1.0	.984	RUN	.969	RUN	1.111	RUN	.958	RUN	.952	RUN	.949	RUN
.33 1.0	1.015	49/1	1.006	49/2	1.156	50/0	1.047	136/0	1.018	137/0	1.030	138/0
.67 1.0	.000		.000		.000		.000		.000		.000	
	TEST 2		TEST 2		TEST 6		TEST 6		TEST 6		TEST 6	
0 .52	.000	.000	.000	.000	.978	.978	.963	.963	.912	.922	.912	.926
0 .84	1.536	1.433	1.626	.000	.987	.985	.968	.966	.927	.937	.918	.925
.03 1.0	1.352	RUN	1.374	RUN	.984	RUN	.971	RUN	.920	RUN	.918	RUN
.33 1.0	1.341	237/0	1.431	236/0	.998	8	.995	8	.981	21	.990	21
.67 1.0	.000		.000		1.005		1.004		1.000		1.006	
	TEST 6		TEST 6		TEST 6		TEST 6		TEST 6		TEST 6	
0 .52	.971	.976	.942	.945	.912	.919	.845	.847	.788	.791	.640	.646
0 .84	.980	.983	.952	.953	.921	.929	.847	.850	.807	.807	.642	.650
.03 1.0	.977	RUN	.955	RUN	.922	RUN	.869	RUN	.899	RUN	.884	RUN
.33 1.0	.996	5	.992	5	.977	18	.969	18	.985	15/2	.992	15
.67 1.0	1.000		1.000		.995		.993		.962		.962	
	TEST 2		TEST 2		TEST 2		TEST 2		TEST 2		TEST 2	
0 .52		.706		.711		.638		.630		.000		.000
0 .84	.737	.707	.705	.722	.728	.697	.619	.626	.364	.000	.341	.000
.03 1.0	.957	RUN	.986	RUN	.955	RUN	.000	RUN	.912	RUN	.898	RUN
.33 1.0	.984	47/0	1.017	47/1	.994	47/2	.922	72/0	.975	48/0	.964	48/1
.67 1.0	1.002		1.015		1.007		.907		.000		.000	
	TEST 2		TEST 2		TEST 2		TEST 6		TEST 6		TEST 2	
0 .52		.000		.000		.000		.976		.957		.523
0 .84	.318	.000	.783	.000	1.523	1.557	.976	.979	.949	.955	.515	.511
.03 1.0	.920	RUN	.895	RUN	1.385	RUN	.972	RUN	.954	RUN	.888	RUN
.33 1.0	.949	48/2	.969	161/0	1.237	261/0	.991	11	.989	11	.926	27/0
.67 1.0	.000		.000		.000		.992		.995		.897	

TABLE B-1. (Continued)

(B) CONTINUED.

X/D R/R	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$	$\theta=0$	$\theta=60$
0 .52	TEST 2		TEST 2		TEST 2		TEST 2		TEST 2		TEST 2	
0 .84		.627		.716		.181		.594		.821		1.007
.03 1.0		.609 .630		.696 .701		.201 .178		.597 .528		.824 .778		1.005 .953
.33 1.0		.867 RUN		.847 RUN		.838 RUN		1.007 RUN		1.025 RUN		.996 RUN
.67 1.0		.886 28/0		.878 29/0		.893 41/2		.000 1/1		.000 2/0		.000 3/0
		.895		.863		.907		1.048		1.096		1.059
0 .52	TEST 2		TEST 6		TEST 6		TEST 6		TEST 6		TEST 6	
0 .84		.000 1.029		.975 .979		.945 .954		.961 .965		.908 .918		.858 .866
.03 1.0		1.032 1.015		.979 .982		.945 .961		.967 .962		.919 .929		.857 .861
.33 1.0		1.032 RUN		.976 RUN		.953 RUN		.973 RUN		.913 RUN		.870 RUN
.67 1.0		.000 4/2		.994 24		.991 24		.999 37		.976 43		.976 43
		1.064		.995		.997		1.002		.994		.999
0 .52	TEST 6		TEST 6		TEST 6		TEST 6		TEST 6		TEST 6	
0 .84		.791 .794		.626 .628		.976 .979		.953 .961		.913 .920		.845 .845
.03 1.0		.807 .807		.626 .630		.983 .983		.956 .963		.922 .929		.845 .844
.33 1.0		.876 RUN		.859 RUN		.981 RUN		.964 RUN		.924 RUN		.868 RUN
.67 1.0		.978 56		.986 56		.995 27/2		.992 27		.977 34		.969 34
		.959		.956		1.000		1.000		.994		.991
0 .52	TEST 6		TEST 6		TEST 6		TEST 2		TEST 2		TEST 2	
0 .84		.987 .988		.792 .792		.676 .682		.000 .706		.000 .711		.000 .686
.03 1.0		.980 .984		.814 .807		.680 .683		.737 .707		.705 .722		.728 .697
.33 1.0		.981 RUN		.893 RUN		.881 RUN		.957 RUN		.986 RUN		.955 RUN
.67 1.0		1.008 62		.996 50		1.000 50		.984 47/0		1.017 47/1		.994 47/2
		1.016		.974		.970		1.002		1.015		1.007
0 .52	TEST 2		TEST 2		TEST 2		TEST 2		TEST 2		TEST 2	
0 .84		.717		.818		.000		.000		.000		1.004
.03 1.0		.699 .704		.811 .809		.364 .000		.341 .000		.318 .000		1.007 .989
.33 1.0		.000 RUN		.000 RUN		.912 RUN		.898 RUN		.920 RUN		.000 RUN
.67 1.0		.882 70/0		.867 71/0		.975 48/0		.964 48/1		.949 48/2		1.096 62/2
		.907		.899		.000		.000		.000		1.093
0 .52	TEST 2		TEST 6		TEST 6		TEST 6		TEST 6		TEST 6	
0 .84		.000 .000		.973 .976		.949 .960		.965 .969		1.024 1.035		.901 .910
.03 1.0		1.187 .000		.976 .979		.948 .955		.961 .967		1.023 1.025		.909 .919
.33 1.0		.972 RUN		.972 RUN		.954 RUN		.965 RUN		1.024 RUN		.895 RUN
.67 1.0		.972 163/0		.991 31		.989 31		.992 66		1.031 40		.973 47
		.000		.990		.992		.996		1.030		.980

TABLE B-1. (Concluded)

(B) CONCLUDED.

X/D R/R	$\theta=0$	$=60$	$\theta=0$	$=60$	$\theta=0$	$=60$	$\theta=0$	$=60$	$\theta=0$	$=60$	$\theta=0$	$=60$
	TEST 6		TEST 6		TEST 6							
0 .52	.906	.907	.781	.786	.779	.787						
0 .84	.904	.906	.802	.804	.732	.785						
.03 1.0	.895	RUN	.872	RUN	.868	RUN						
.33 1.0	.986	47	.977	53	.987	53						
.67 1.0	.991		.964		.959							



TABLE B-2. BASE AND BODY SURFACE PRESSURE RATIOS ( $P/P_{\infty}$ ) FOR ORBITER GEOMETRY

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
TEST 3, RUN 220/0		TEST 3, RUN 215/0			TEST 3, RUN 210/0			TEST 3, RUN 209/0			TEST 3, RUN 204/0		
0	0	.000			.000			.000			.000		
0	.52		.000			.000			.000			.000	
0	.84	.980	.000	.000	.931	.000	.000	.932	.000	.000	.918	.000	.000
.03	1.0	.000	.986	.000	.000	.955	.000	.000	.964	.000	.000	.952	.000
.22	1.0	.000	.993		.000	.978		.000	.990		.000	.942	
.40	1.0	.996	.992		.984	.983		.991	.992		.990	.991	
.58	1.0	.996	.998		.987	.989		.995	.997		.994	.996	
.76	1.0	.996	.998	1.003	.989	.991	.995	.997	.999	1.004	.996	.998	1.004
.94	1.0	1.007	.000		.998	.000		1.006	.000		1.005	.000	
1.12	1.0	.996	1.001	1.009	.990	.995	1.003	.998	1.004	1.011	.998	1.003	1.011
1.30	1.0	.998	1.001		.993	.996		1.001	1.004		1.001	1.003	
1.48	1.0	.994	.988		.990	.984		.998	.993		.998	.993	
1.84	1.0	.996			.992			1.001			1.000		
2.20	1.0	.994	.994	1.022	.991	.991	1.016	.999	1.000	1.024	.998	.999	1.024
2.56	1.0	.996			.992			1.000			1.000		
2.92	1.0	.997	.000		.993	.000		1.002	.000		1.001	.000	
3.28	1.0	.998			.994			1.003			1.003		
TEST 3, RUN 219/0		TEST 3, RUN 216/0			TEST 3, RUN 223/0								
0	0	.000			.000			.000			.000		
0	.52		.000			.000			.000			.000	
0	.84	.920	.000	.000	.927	.000	.000	.833	.000	.000	.840	.000	.000
.03	1.0	.000	.949	.000	.000	.940	.000	.000	.872	.000	.000	.881	.000
.22	1.0	.000	.977		.000	.980		.000	.952		.000	.952	
.40	1.0	.983	.984		.990	.971		.974	.961		.972	.960	
.58	1.0	.987	.989		.994	.995		.984	.986		.984	.986	
.76	1.0	.989	.991	.997	.998	.998	1.017	.989	.991	1.011	.987	.989	1.010
.94	1.0	.992	.000		1.020	.000		1.009	.000		1.007	.000	
1.12	1.0	.991	.996	1.003	.982	1.002	1.035	.980	.998	1.031	.978	.997	1.028
1.30	1.0	.993	.996		.990	1.000		.987	.998		.987	.997	
1.48	1.0	.990	.985		.977	.953		.976	.952		.974	.953	
1.84	1.0	.993			.979			.977			.978		
2.20	1.0	.991	.992	1.016	.966	.961	1.054	.963	.958	1.041	.963	.960	1.040
2.56	1.0	.992			.960			.958			.960		
2.92	1.0	.994	.000		.967	.000		.965	.000		.966	.000	
3.28	1.0	.995			.975			.974			.975		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
	TEST 3, RUN 214/0			TEST 3, RUN 211/0			TEST 3, RUN 208/0			TEST 3, RUN 205/0		
0 0	.000			.000			.000			.000		
0 .52		.000			.000			.000			.000	
0 .84	.835	.000	.000	.783	.000	.000	.783	.000	.000	.825	.000	.000
.03 1.0	.000	.882	.000	.000	.854	.000	.000	.858	.000	.000	.878	.000
.22 1.0	.000	1.340		.000	1.343		.000	.950		.000	1.253	
.40 1.0	.967	.958		.966	.958		.969	.959		.972	.962	
.58 1.0	.981	.983		.978	.982		.981	.983		.983	.987	
.76 1.0	.984	.987	1.004	.965	.986	1.007	.986	.988	1.009	.988	.992	1.012
.94 1.0	1.005	.000		1.006	.000		1.007	.000		1.009	.000	
1.12 1.0	.974	.994	1.025	.976	.995	1.027	.976	.997	1.028	.978	.998	1.028
1.30 1.0	.983	.993		.963	.995		.984	.996		.986	.996	
1.48 1.0	.971	.950		.972	.952		.972	.951		.976	.954	
1.84 1.0	.976			.974			.975			.977		
2.20 1.0	.961	.956	1.036	.962	.958	1.034	.962	.959	1.038	.964	.962	1.034
2.56 1.0	.957			.957			.959			.960		
2.92 1.0	.963	.000		.964	.000		.965	.000		.966	.000	
3.28 1.0	.972			.973			.974			.974		
	TEST 3, RUN 218/0			TEST 3, RUN 217/0			TEST 3, RUN 224/0			TEST 3, RUN 213/1		
0 0	.000			.000			.000			.000		
0 .52		.000			.000			.000			.000	
0 .84	.750	.000	.000	.574	.000	.000	.523	.000	.000	.415	.000	.000
.03 1.0	.000	.906	.000	.000	.877	.000	.000	.886	.000	.000	.886	.000
.22 1.0	.000	.991		.000	1.926		.000	1.948		.000	1.921	
.40 1.0	1.010	.983		.998	.984		.993	.986		.989	.981	
.58 1.0	1.021	.995		1.007	1.003		1.022	.995		1.007	.995	
.76 1.0	1.024	1.016	1.017	1.028	.991	1.831	1.024	1.008	1.022	1.016	.998	1.152
.94 1.0	1.047	.000		1.038	.000		1.040	.000		1.037	.000	
1.12 1.0	1.010	1.022	.995	1.005	1.025	.997	1.011	1.021	1.000	1.007	1.020	.997
1.30 1.0	1.027	1.016		1.028	1.023		1.026	1.019		1.022	1.018	
1.48 1.0	.968	.959		.966	.961		.977	.966		.975	.960	
1.84 1.0	.985			1.000			.985			.982		
2.20 1.0	.960	.952	1.158	.953	.941	1.141	.966	.950	1.131	.955	.943	1.131
2.56 1.0	.986			.979			.985			.982		
2.92 1.0	.953	.000		.969	.000		.954	.000		.954	.000	
3.28 1.0	.988			.976			.983			.978		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
	TEST 3, RUN 212/0			TEST 3, RUN 222/0			TEST 3, RUN 221/0			TEST 3, RUN 206/0		
0 C	.000			.000			.000			.000		
0 .52		.000			.000			.000			.000	
0 .84	.487	.000	.000	.596	.000	.000	.657	.000	.000	.713	.000	.000
.03 1.0	.000	.948	.000	.000	.889	.000	.000	.898	.000	.000	.987	.000
.22 1.0	.000	1.906		.000	.990		.000	.991		.000	1.061	
.40 1.0	.992	.984		.990	.986		.991	.987		.963	1.047	
.53 1.0	1.008	1.002		1.014	.991		1.015	.996		.963	1.018	
.76 1.0	1.021	.991	1.417	1.021	1.009	1.021	1.022	1.009	1.024	.944	.973	1.073
.94 1.0	1.039	.000		1.045	.000		1.044	.000		.953	.000	
1.12 1.0	1.007	1.023	1.038	1.013	1.021	1.003	1.013	1.020	1.005	.964	.962	1.166
1.30 1.0	1.027	1.021		1.024	1.016		1.025	1.018		.989	.945	
1.48 1.0	.979	.961		.975	.968		.973	.964		.942	.871	
1.64 1.0	.991			.976			.974			.946		
2.20 1.0	.948	.944	1.131	.967	.947	1.119	.965	.945	1.116	.931	.941	.995
2.56 1.0	.980			.986			.983			.956		
2.92 1.0	.963	.000		.956	.000		.959	.000		.954	.000	
3.28 1.0	.977			.978			.974			.991		
	TEST 3, RUN 195/0			TEST 3, RUN 194/0			TEST 3, RUN 207/0			TEST 3, RUN 196/0		
0 0	.000			.000			.000			.000		
0 .52		.000			.000			.000			.000	
0 .84	.492	.000	.000	.526	.000	.000	.488	.000	.000	.387	.000	.000
.03 1.0	.000	.970	.000	.000	.958	.000	.000	.969	.000	.000	.977	.000
.22 1.0	.000	1.065		.000	1.044		.000	2.571		.000	1.046	
.40 1.0	.926	1.031		.963	1.034		.972	1.038		.973	1.043	
.58 1.0	.970	1.022		.954	1.007		.972	1.015		.966	1.021	
.76 1.0	.961	.962	1.051	.941	.982	1.076	.949	.985	1.081	.943	.977	1.082
.94 1.0	.991	.000		.947	.000		.950	.000		.945	.000	
1.12 1.0	.932	.936	1.144	.971	.957	1.175	.955	.956	1.161	.958	.957	1.164
1.30 1.0	.963	.952		.979	.946		.991	.952		.992	.951	
1.48 1.0	.944	.854		.950	.884		.960	.882		.944	.879	
1.64 1.0	.971			.951			.956			.948		
2.20 1.0	.932	.956	.991	.947	.952	.976	.933	.944	.976	.939	.945	.981
2.56 1.0	.946			.962			.965			.957		
2.92 1.0	.968	.000		.959	.000		.958	.000		.953	.000	
3.28 1.0	.986			.960			.984			.988		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
	TEST 3, RUN 199/0			TEST 3, RUN 198/0			TEST 3, RUN 197/0			TEST 3, RUN 201/0		
0 0	.000			.000			.000			.000		
0 .52		.000			.000			.000			.000	
0 .84	.396	.000	.000	.513	.000	.000	.516	.000	.000	.619	.000	.000
.03 1.0	.000	.955	.000	.000	.957	.000	.000	.966	.000	.000	.974	.000
.22 1.0	.000	1.043		.000	1.523		.000	1.047		.000	2.561	
.40 1.0	.981	1.038		.973	1.041		.959	1.040		.997	1.033	
.58 1.0	.979	1.014		.970	1.017		.967	1.005		1.000	1.019	
.76 1.0	.955	.984	1.079	.945	.982	1.078	.946	.982	1.079	.969	.984	1.078
.94 1.0	.954	.000		.954	.000		.951	.000		.958	.000	
1.12 1.0	.973	.958	1.161	.974	.960	1.162	.973	.958	1.176	.976	.959	1.170
1.30 1.0	.990	.951		.988	.953		.976	.949		.987	.953	
1.48 1.0	.949	.884		.948	.883		.943	.877		.948	.672	
1.64 1.0	.951			.950			.947			.952		
2.20 1.0	.944	.948	.974	.943	.947	.967	.939	.945	.990	.946	.995	.986
2.56 1.0	.966			.963			.951			.963		
2.92 1.0	.960	.000		.958	.000		.956	.000		.960	.000	
3.28 1.0	.984			.986			.979			.983		
	TEST 3, RUN 200/0			TEST 3, RUN 203/0			TEST 3, RUN 202/0			TEST 3, RUN 125/0		
0 0	.000			.000			.000			.981		
0 .52		.000			.000			.000			.979	
0 .84	.621	.000	.000	.684	.000	.000	.686	.000	.000	.978	.000	.978
.03 1.0	.000	.949	.000	.000	.951	.000	.000	.966	.000	.000	.000	.000
.22 1.0	.000	1.048		.000	1.048		.000	1.065		.000	.000	
.40 1.0	.963	1.031		.966	1.030		.963	1.021		.000	.000	
.58 1.0	.998	1.018		.995	1.007		1.005	1.034		.000	.000	
.76 1.0	.980	.984	1.035	.979	.985	1.079	.993	.968	1.090	.000	.000	.000
.94 1.0	.987	.000		.973	.000		.955	.000		.000	.000	
1.12 1.0	.958	.948	1.175	.967	.944	1.162	.945	.944	1.174	.994	.999	1.007
1.30 1.0	.976	.958		.978	.953		.969	.955		.997	.999	
1.48 1.0	.950	.879		.951	.860		.937	.855		.993	.990	
1.64 1.0	.966			.960			.972			.000		
2.20 1.0	.951	.957	.966	.949	.949	.963	.938	.958	.990	.994	.994	1.021
2.56 1.0	.956			.958			.951			.995		
2.92 1.0	.979	.000		.970	.000		.976	.000		.996	.000	
3.28 1.0	.989			.985			.987			.998		



TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
TEST 3, RUN 121/0		TEST 3, RUN 114/0			TEST 3, RUN 115/0			TEST 3, RUN 120/0			TEST 3, RUN 136/0		
0	0	.975			.977			.983			.976		
0	.52		.950			.952			.952			.971	
0	.84	.928	.000	.933	.929	.000	.934	.912	.000	.926	.929	.000	.944
.03	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.22	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.40	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.58	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12	1.0	.992	.997	1.005	.992	.998	1.006	.991	.996	1.004	.991	.997	1.005
1.30	1.0	.995	.997		.994	.998		.994	.996		.994	.997	
1.48	1.0	.992	.988		.992	.988		.990	.987		.991	.987	
1.84	1.0	.000			.000			.000			.000		
2.20	1.0	.994	.993	1.017	.993	.994	1.019	.992	.992	1.018	.994	.994	1.019
2.56	1.0	.994			.994			.993			.995		
2.92	1.0	.996	.000		.966	.000		.995	.000		.997	.000	
3.28	1.0	.997			.997			.997			.998		
TEST 3, RUN 130/0		TEST 3, RUN 137/0			TEST 3, RUN 131/0								
0	0	.976			.978			.982			.983		
0	.52		.971			.972			.975			.973	
0	.84	.929	.000	.944	.930	.000	.945	.938	.000	.953	.938	.000	.953
.03	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.22	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.40	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.58	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12	1.0	.991	.997	1.005	.993	.998	1.007	.992	.997	1.005	.991	.996	1.004
1.30	1.0	.994	.997		.996	.999		.994	.998		.994	.997	
1.48	1.0	.992	.987		.993	.990		.992	.988		.991	.987	
1.84	1.0	.000			.000			.000			.000		
2.20	1.0	.993	.993	1.019	.994	.994	1.019	.992	.993	1.019	.992	.993	1.016
2.56	1.0	.994			.995			.993			.992		
2.92	1.0	.995	.000		.997	.000		.995	.000		.994	.000	
3.28	1.0	.996			.998			.997			.995		



TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
0 0	TEST 3, RUN 126/0			TEST 3, RUN 111/0			TEST 3, RUN 124/0			TEST 3, RUN 122/0		
0 .52	.925			.890			.872			.843		
0 .84	.922	.926		.848	.875		.836	.860		.819	.861	
.03 1.0	.000	.000	.919	.000	.000	.848	.000	.000	.840	.000	.000	.829
.22 1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.40 1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.58 1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76 1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94 1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12 1.0	.976	.998	1.034	.979	.999	1.035	.973	.993	1.027	.979	.996	1.032
1.30 1.0	.987	.997		.989	.999		.981	.992		.987	.997	
1.48 1.0	.973	.960		.976	.963		.969	.957		.974	.961	
1.84 1.0	.000			.000			.000			.000		
2.20 1.0	.966	.957	1.053	.967	.961	1.053	.961	.954	1.040	.968	.955	1.044
2.56 1.0	.961			.963			.956			.962		
2.92 1.0	.966	.000		.969	.000		.963	.000		.969	.000	
3.28 1.0	.976			.962			.974			.979		
0 0	TEST 3, RUN 112/0			TEST 3, RUN 116/0			TEST 3, RUN 119/0			TEST 3, RUN 135/0		
0 .52	.838			.807			.813			.878		
0 .84	.814	.857		.770	.813		.774	.817		.846	.874	
.03 1.0	.000	.000	.826	.000	.000	.801	.000	.000	.812	.000	.000	.879
.22 1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.40 1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.58 1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76 1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94 1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12 1.0	.975	.996	1.031	.975	.995	1.032	.978	.997	1.033	.977	.998	1.032
1.30 1.0	.985	.995		.985	.996		.986	.998		.986	.996	
1.48 1.0	.971	.959		.970	.957		.974	.961		.974	.959	
1.84 1.0	.000			.000			.000			.000		
2.20 1.0	.960	.957	1.050	.961	.961	1.047	.967	.956	1.039	.964	.959	1.050
2.56 1.0	.959			.957			.962			.959		
2.92 1.0	.966	.000		.965	.000		.967	.000		.966	.000	
3.28 1.0	.978			.978			.978			.977		

TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
TEST 3, RUN 128/1		TEST 3, RUN 132/0			TEST 3, RUN 138/0			TEST 3, RUN 127/0					
0	0	.831			.961			.959			.778		
0	.52		.376			.922			.923			.764	
0	.84	.849	.000	.834	.899	.000	.924	.901	.000	.924	.750	.000	.817
.03	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.22	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.40	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.53	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12	1.0	.978	.996	1.030	.981	1.000	1.035	.981	1.003	1.036	1.004	1.022	1.002
1.30	1.0	.966	.997		.969	1.000		.992	1.000		1.025	1.024	
1.48	1.0	.974	.961		.977	.963		.977	.965		.969	.976	
1.84	1.0	.000			.000			.000			.000		
2.20	1.0	.964	.958	1.037	.966	.961	1.039	.967	.961	1.052	.957	.943	1.152
2.56	1.0	.960			.961			.962			.984		
2.92	1.0	.966	.000		.966	.000		.967	.000		.960	.000	
3.28	1.0	.977			.978			.980			.989		
TEST 3, RUN 110/1		TEST 3, RUN 109/2			TEST 3, RUN 123/0			TEST 3, RUN 113/0					
0	0	.643			.623			.522			.523		
0	.52		.611			.612			.529			.530	
0	.84	.544	.000	.570	.540	.000	.570	.480	.000	.505	.486	.000	.508
.03	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.22	1.0	.000	.000		.000	.000		.000	.000		.000	.986	
.40	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.58	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12	1.0	1.005	1.024	1.003	1.011	1.023	1.013	1.015	1.021	1.013	1.011	1.021	1.007
1.30	1.0	1.026	1.022		1.027	1.024		1.025	1.020		1.027	1.018	
1.48	1.0	.972	.976		.974	.982		.974	.984		.966	.978	
1.84	1.0	.000			.000			.000			.000		
2.20	1.0	.958	.941	1.149	.965	.946	1.140	.974	.948	1.128	.969	.949	1.150
2.56	1.0	.982			.987			.991			.987		
2.92	1.0	.961	.000		.963	.000		.960	.000		.956	.000	
3.28	1.0	.989			.990			.987			.994		

TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
TEST 3, RUN 117/0		TEST 3, RUN 118/0			TEST 3, RUN 134/0			TEST 3, RUN 129/0					
0	0	.628			.636			.775			.788		
0	.52		.644			.651			.740			.748	
0	.84	.601	.000	.639	.605	.000	.648	.713	.000	.743	.720	.000	.751
.03	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.22	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.40	1.0	.000	.000		.000	.000		.000	.000		.945	.000	
.58	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12	1.0	1.007	1.022	1.004	1.014	1.023	1.015	1.002	1.029	1.007	1.014	1.024	1.016
1.30	1.0	1.026	1.019		1.025	1.022		1.029	1.024		1.031	1.027	
1.48	1.0	.970	.976		.975	.985		.975	.968		.000	.980	
1.84	1.0	.000			.000			.000			.000		
2.20	1.0	.958	.939	1.148	.970	.949	1.125	.950	.937	1.152	.981	.000	1.134
2.56	1.0	.985			.989			.977			.987		
2.92	1.0	.957	.000		.963	.000		.968	.000		.972	.000	
3.28	1.0	.989			.984			.977			.984		
TEST 3, RUN 139/1		TEST 3, RUN 133/0			TEST 3, RUN 150/0			TEST 3, RUN 148/0					
0	0	.887			.891			.733			.619		
0	.52		.811			.805			.756			.620	
0	.84	.791	.000	.972	.784	.000	.809	.709	.000	.792	.471	.000	.496
.03	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.22	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.40	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.58	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12	1.0	1.030	.921	.970	1.007	1.017	1.020	.976	.954	1.178	.978	.951	1.187
1.30	1.0	.973	.981		1.012	1.018		.984	.950		.976	.950	
1.48	1.0	.975	.950		.956	.978		.947	.882		.948	.891	
1.84	1.0	.000			.000			.000			.000		
2.20	1.0	.921	.996	1.010	.979	.943	1.111	.941	.946	.987	.947	.948	.986
2.56	1.0	.961			.991			.956			.958		
2.92	1.0	.988	.000		.965	.000		.961	.000		.964	.000	
3.28	1.0	1.006			.991			.986			.988		

TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
TEST 3, RUN 149/0		TEST 3, RUN 146/0			TEST 3, RUN 145/1			TEST 3, RUN 144/1			TEST 3, RUN 147/0		
0	0	.596			.547			.555			.673		
0	.52		.596			.639			.670			.722	
0	.84	.450	.000	.481	.507	.000	.536	.509	.000	.543	.628	.000	.663
.03	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.22	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.40	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.58	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12	1.0	.980	.948	1.185	.971	.953	1.174	.976	.950	1.167	.975	.955	1.173
1.30	1.0	.976	.953		.981	.948		.985	.952		.981	.949	
1.48	1.0	.951	.894		.944	.884		.950	.895		.951	.887	
1.64	1.0	.000			.000			.000			.000		
2.20	1.0	.947	.950	.977	.942	.941	.989	.947	.949	.974	.946	.949	.984
2.56	1.0	.959			.959			.964			.957		
2.92	1.0	.966	.000		.959	.000		.963	.000		.958	.000	
3.28	1.0	.985			.982			.983			.983		
TEST 3, RUN 142/0		TEST 3, RUN 141/0			TEST 3, RUN 140/0								
0	0	.673			.368			.856			.965		
0	.52		.722			.802			.790			.847	
0	.84	.628	.000	.663	.772	.000	.787	.767	.000	.783	.834	.000	.845
.03	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.22	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.40	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.58	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
.76	1.0	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000
.94	1.0	.000	.000		.000	.000		.000	.000		.000	.000	
1.12	1.0	.975	.955	1.173	.985	.966	1.196	.983	.962	1.207	.976	.961	1.206
1.30	1.0	.981	.949		1.002	.977		.996	.971		.993	.971	
1.48	1.0	.951	.887		.973	.911		.969	.904		.964	.903	
1.64	1.0	.000			.000			.000			.000		
2.20	1.0	.946	.949	.984	.976	.973	.991	.967	.967	1.009	.965	.966	1.008
2.56	1.0	.957			.978			.972			.969		
2.92	1.0	.958	.000		.997	.000		.984	.000		.985	.000	
3.28	1.0	.983			1.012			1.003			1.004		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
	TEST 3, RUN 143/0			TEST 3, RUN 68/0			TEST 3, RUN 67/0			TEST 3, RUN 56/0		
0 0	.967			.960			.963			.964		
0 .52		.849			.978			.945			.948	
0 .84	.823	.000	.830	.980	.982	.977	.928	.932	.936	.933	.936	.936
.03 1.0	.000	.000	.000	.986	.985	.985	.953	.953	.961	.957	.956	.961
.22 1.0	.000	.000		.000	.992		.000	.975		.000	.976	
.40 1.0	.000	.000		.995	.995		.984	.984		.985	.985	
.58 1.0	.000	.000		.999	.998		.990	.990		.991	.991	
.76 1.0	.000	.000	.000	.999	.999	1.003	.992	.994	.998	.992	.995	.998
.94 1.0	.000	.000		1.007	1.003		1.001	.996		1.001	.997	
1.12 1.0	.949	.943	1.169	.996	1.001	1.009	.992	.997	1.005	.992	.997	1.005
1.30 1.0	.979	.953		.998	1.001		.995	.997		.995	.997	
1.48 1.0	.942	.873		.994	.993		.991	.989		.992	.990	
1.64 1.0	.000			.997			.994			.994		
2.20 1.0	.953	.958	.974	.996	.996	1.021	.994	.994	1.020	.994	.994	1.019
2.56 1.0	.960			.995			.994			.994		
2.92 1.0	.982	.000		.997	.000		.995	.000		.996	.000	
3.28 1.0	.975			.999			.998			.998		
	TEST 3, RUN 62/0			TEST 3, RUN 61/0			TEST 3, RUN 76/0			TEST 3, RUN 71/0		
0 0	.969			.956			.969			.969		
0 .52		.952			.926			.947			.940	
0 .84	.922	.928	.924	.914	.913	.915	.918	.914	.914	.918	.911	.913
.03 1.0	.953	.954	.957	.951	.944	.950	.945	.944	.949	.946	.939	.949
.22 1.0	.000	.976		.000	.972		.000	.988		.000	.971	
.40 1.0	.985	.985		.985	.983		.981	.980		.982	.981	
.58 1.0	.991	.991		.991	.990		.987	.987		.989	.988	
.76 1.0	.992	.994	.999	.992	.994	.997	.989	.991	.995	.990	.992	.997
.94 1.0	1.001	.998		1.002	.997		.997	.993		1.001	.994	
1.12 1.0	.993	.998	1.006	.992	.997	1.005	.990	.994	1.002	.991	.996	1.004
1.30 1.0	.996	.999		.995	.998		.992	.995		.994	.997	
1.48 1.0	.993	.991		.992	.990		.989	.987		.991	.988	
1.64 1.0	.996			.995			.992			.993		
2.20 1.0	.995	.996	1.020	.994	.994	1.020	.991	.992	1.015	.993	.993	1.019
2.56 1.0	.995			.994			.991			.993		
2.92 1.0	.997	.000		.996	.000		.993	.000		.995	.000	
3.28 1.0	.999			.998			.995			.997		



TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
TEST 3, RUN 77/0		TEST 3, RUN 82/1			TEST 3, RUN 83/0			TEST 3, RUN 88/0					
0	0	.959			.961			.967			.965		
0	.52		.943			.945			.959			.956	
0	.84	.911	.913	.917	.914	.916	.919	.925	.928	.932	.922	.925	.930
.03	1.0	.944	.942	.948	.947	.944	.951	.954	.951	.957	.950	.948	.954
.22	1.0	.000	.969		.000	.951		.000	.944		.000	.957	
.40	1.0	.979	.980		.982	.981		.983	.983		.982	.981	
.58	1.0	.987	.986		.989	.988		.990	.989		.989	.989	
.76	1.0	.988	.989	.995	.990	.991	.997	.991	.992	.997	.990	.992	.997
.94	1.0	.997	.993		1.000	.994		1.001	.995		1.000	.994	
1.12	1.0	.989	.993	1.002	.991	.995	1.004	.991	.995	1.001	.990	.995	1.003
1.30	1.0	.992	.994		.994	.996		.994	.996		.994	.996	
1.48	1.0	.988	.984		.999	.987		.991	.987		.990	.987	
1.64	1.0	.991			.992			.994			.992		
2.20	1.0	.991	.990	1.016	.993	.993	1.018	.993	.993	1.018	.992	.992	1.017
2.56	1.0	.991			.992			.993			.993		
2.92	1.0	.992	.000		.994	.000		.995	.000		.994	.000	
3.28	1.0	.994			.997			.996			.996		
TEST 3, RUN 69/0		TEST 3, RUN 66/0			TEST 3, RUN 57/0			TEST 3, RUN 60/0					
0	0	.954			.932			.941			.937		
0	.52		.956			.903			.904			.917	
0	.84	.955	.963	.952	.985	.890	.891	.889	.891	.893	.877	.885	.878
.03	1.0	.969	.968	.968	.921	.920	.930	.922	.921	.932	.920	.919	.926
.22	1.0	.000	.982		.000	.956		.000	.957		.000	.956	
.40	1.0	.987	.988		.971	.972		.972	.971		.972	.971	
.58	1.0	.994	.994		.983	.982		.984	.983		.983	.983	
.76	1.0	.994	.996	1.004	.984	.988	.998	.985	.988	.997	.986	.989	.998
.94	1.0	1.011	1.004		1.001	.994		1.003	.995		1.004	.995	
1.12	1.0	.988	.998	1.015	.984	.992	1.011	.982	.993	1.011	.983	.993	1.011
1.30	1.0	.993	.998		.990	.995		.988	.994		.989	.994	
1.48	1.0	.985	.982		.982	.978		.981	.977		.982	.978	
1.64	1.0	.989			.986			.986			.986		
2.20	1.0	.987	.987	1.039	.984	.985	1.035	.983	.984	1.037	.964	.985	1.037
2.56	1.0	.986			.984			.983			.984		
2.92	1.0	.989	.000		.987	.000		.986	.000		.987	.000	
3.28	1.0	.993			.991			.991			.992		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
	TEST 3, RUN 63/1			TEST 3, RUN 75/0			TEST 3, RUN 72/0			TEST 3, RUN 81/0		
0 0	.942			.909			.906			.907		
0 .52		.919			.889			.887			.903	
0 .84	.880	.887	.882	.846	.859	.857	.845	.854	.858	.862	.873	.880
.03 1.0	.920	.921	.926	.901	.899	.910	.982	.897	.909	.910	.908	.921
.22 1.0	.000	.958		.000	.948		.000	.948		.000	.953	
.40 1.0	.972	.972		.966	.965		.967	.967		.969	.968	
.58 1.0	.983	.984		.979	.978		.981	.988		.962	.981	
.76 1.0	.987	.989	.998	.982	.985	.994	.983	.986	.996	.984	.986	.997
.94 1.0	1.003	.996		.997	.991		1.002	.993		1.002	.992	
1.12 1.0	.985	.995	1.012	.980	.991	1.003	.982	.991	1.009	.981	.992	1.009
1.30 1.0	.990	.995		.986	.991		.988	.993		.988	.992	
1.48 1.0	.983	.979		.980	.973		.980	.975		.979	.973	
1.84 1.0	.987			.984			.985			.984		
2.20 1.0	.986	.986	1.037	.982	.983	1.031	.983	.983	1.036	.983	.983	1.035
2.56 1.0	.985			.981			.983			.982		
2.92 1.0	.989	.000		.984	.000		.986	.000		.985	.000	
3.28 1.0	.993			.989			.991			.990		
	TEST 3, RUN 78/0			TEST 3, RUN 84/0			TEST 3, RUN 87/0			TEST 3, RUN 70/0		
0 0	.904			.920			.920			.918		
0 .52		.901			.922			.921			.921	
0 .84	.859	.870	.877	.882	.895	.902	.880	.893	.901	.925	.929	.915
.03 1.0	.907	.905	.915	.923	.921	.933	.921	.921	.932	.947	.946	.950
.22 1.0	.000	1.045		.000	1.105		.000	1.114		.000	.972	
.40 1.0	.967	.967		.973	.973		.972	.972		.983	.984	
.58 1.0	.980	.979		.984	.984		.984	.983		.996	.995	
.76 1.0	.983	.985	.995	.985	.989	.997	.986	.988	.998	.996	1.000	1.018
.94 1.0	.999	.991		1.004	.994		1.002	.994		1.019	1.009	
1.12 1.0	.980	.991	1.009	.983	.994	1.011	.983	.994	1.010	.983	1.000	1.035
1.30 1.0	.987	.991		.989	.995		.989	.995		.991	.998	
1.48 1.0	.979	.971		.982	.974		.981	.974		.976	.970	
1.84 1.0	.983			.985			.986			.979		
2.20 1.0	.982	.981	1.032	.984	.985	1.036	.984	.983	1.033	.971	.965	1.054
2.56 1.0	.980			.984			.983			.965		
2.92 1.0	.984	.000		.987	.000		.986	.000		.970	.000	
3.28 1.0	.988			.991			.991			.982		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 3, RUN 65/0			TEST 3, RUN 58/0			TEST 3, RUN 64/0			TEST 3, RUN 59/0		
0 0	.857			.888			.823			.830		
0 .52		.851			.851			.851			.853	
0 .84	.819	.840	.820	.824	.829	.828	.800	.828	.797	.805	.826	.804
.03 1.0	.884	.884	.899	.837	.884	.905	.876	.884	.892	.880	.881	.894
.22 1.0	.000	.945		.000	.949		.000	.944		.000	.944	
.40 1.0	.966	.966		.968	.969		.965	.965		.967	.967	
.58 1.0	.985	.983		.987	.987		.985	.983		.984	.983	
.76 1.0	.935	.990	1.008	.990	.993	1.012	.984	.991	1.010	.987	.991	1.007
.94 1.0	1.009	1.000		1.016	1.003		1.009	1.001		1.012	1.001	
1.12 1.0	.976	.991	1.028	.976	.995	1.032	.976	.992	1.029	.977	.994	1.029
1.30 1.0	.985	.994		.986	.994		.985	.993		.985	.994	
1.48 1.0	.972	.965		.970	.966		.972	.963		.972	.966	
1.84 1.0	.973			.972			.975			.976		
2.20 1.0	.963	.964	1.045	.962	.957	1.047	.966	.959	1.039	.968	.964	1.052
2.56 1.0	.961			.957			.958			.963		
2.92 1.0	.968	.000		.963	.000		.965	.000		.969	.000	
3.28 1.0	.979			.980			.979			.981		
	TEST 3, RUN 74/1			TEST 3, RUN 73/0			TEST 3, RUN 80/0			TEST 3, RUN 79/0		
0 0	.782			.783			.805			.797		
0 .52		.794			.796			.823			.814	
0 .84	.734	.764	.768	.747	.766	.768	.778	.800	.890	.770	.793	.805
.03 1.0	.858	.854	.880	.861	.855	.834	.867	.866	.890	.864	.862	.887
.22 1.0	.000	.937		.000	.939		.000	.000		.000	.939	
.40 1.0	.961	.961		.965	.965		.963	.961		.962	.963	
.58 1.0	.981	.979		.983	.983		.983	.980		.980	.981	
.76 1.0	.983	.988	1.007	.986	.992	1.008	.983	.988	1.006	.982	.988	1.007
.94 1.0	1.006	.998		1.011	.999		1.007	.999		1.007	.997	
1.12 1.0	.973	.998	1.027	.976	.993	1.029	.973	.990	1.025	.974	.990	1.027
1.30 1.0	.982	.991		.984	.993		.982	.991		.983	.992	
1.48 1.0	.969	.960		.971	.962		.969	.957		.968	.956	
1.84 1.0	.972			.974			.973			.970		
2.20 1.0	.962	.960	1.039	.966	.961	1.048	.963	.961	1.047	.961	.958	1.033
2.56 1.0	.957			.959			.957			.956		
2.92 1.0	.963	.000		.966	.000		.964	.000		.963	.000	
3.28 1.0	.975			.978			.976			.976		

TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$	$\theta=0$	$=60$	$=180$
		TEST 3, RUN 8610			TEST 3, RUN 8510								
0	0	.832			.832								
0	.52		.842			.840							
0	.84	.805	.828	.842	.806	.828	.840						
.03	1.0	.861	.879	.905	.876	.883	.876						
.22	1.0	.000	.948		.000	1.354							
.40	1.0	.969	.986		.961	.961							
.58	1.0	.987	.986		.981	.979							
.76	1.0	.990	.994	1.013	.983	.986	.907						
.94	1.0	1.011	1.003		1.006	.995							
1.12	1.0	.977	.998	1.030	.969	.989	.997						
1.30	1.0	.986	.996		.978	.988							
1.48	1.0	.971	.958		.964	.951							
1.64	1.0	.973			.968								
2.20	1.0	.966	.960	1.040	.959	.954	1.042						
2.56	1.0	.958			.953								
2.92	1.0	.965	.000		.959	.000							
3.28	1.0	.978			.972								

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 1, RUN 472/0			TEST 1, RUN 423/0			TEST 1, RUN 455/0			TEST 1, RUN 454/0		
0 0	.907			.788			.792			.900		
0 .52		.000			.000			.000			.000	
0 .84	.915	.910	.905	.967	.786	.808	.770	.790	.812	.861	.877	.889
.03 1.0	.940	.000	.952	.864	.000	.895	.865	.000	.896	.903	.000	.934
.22 1.0	.972	.970		.945	.944		.947	.947		.960	.962	
.40 1.0	.985	.982		.970	.965		.971	.967		.979	.977	
.58 1.0	.993	.993		.982	.983		.982	.985		.988	.991	
.76 1.0	.996	.998	1.016	.988	.989	1.008	.989	.992	1.010	.994	.996	1.014
.94 1.0	1.024	1.018		1.015	1.010		1.017	1.011		1.020	1.012	
1.12 1.0	.978	.994	1.037	.974	.990	1.030	.976	.992	1.031	.976	.994	1.033
1.30 1.0	.984	.991		.982	.989		.984	.991		.987	.993	
1.48 1.0	.974	.965		.970	.963		.972	.962		.974	.965	
1.84 1.0	.971			.969			.972			.974		
2.20 1.0	.966	.950	1.050	.961	.950	1.047	.964	.953	1.046	.968	.957	1.045
2.56 1.0	.956			.957			.959			.959		
2.92 1.0	.967	.971		.969	.966		.970	.969		.971	.972	
3.28 1.0	.984			.963			.982			.985		
	TEST 1, RUN 422/0			TEST 1, RUN 457/0			TEST 1, RUN 425/0			TEST 1, RUN 453/0		
0 0	.912			.928			.958			.999		
0 .52		.000			.000			.000			.000	
0 .84	.870	.887	.897	.861	.897	.907	.908	.914	.932	.917	.927	.935
.03 1.0	.911	.000	.939	.915	.000	.945	.934	.000	.963	.936	.000	.961
.22 1.0	.961	.962		.962	.962		.975	.972		.961	.964	
.40 1.0	.980	.975		.978	.976		.987	.975		.968	.974	
.58 1.0	.989	.993		.988	.988		.997	1.008		.972	.974	
.76 1.0	.993	.998	1.015	.992	.994	1.014	.999	1.002	1.021	.973	.977	.994
.94 1.0	1.023	1.017		1.017	1.043		1.024	1.021		.999	1.225	
1.12 1.0	.979	.993	1.035	.980	.992	1.030	.979	.998	1.037	.955	.972	1.009
1.30 1.0	.984	.991		.984	.990		.988	.995		.961	.968	
1.48 1.0	.972	.964		.976	.961		.975	.966		.949	.940	
1.84 1.0	.969			.974			.971			.944		
2.20 1.0	.964	.949	1.048	.968	.957	1.038	.962	.949	1.048	.939	.925	1.019
2.56 1.0	.958			.962			.955			.931		
2.92 1.0	.967	.969		.968	.970		.969	.967		.940	.943	
3.28 1.0	.983			.982			.983			.956		



TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 421/0			TEST 1, RUN 459/0			TEST 1, RUN 452/0			TEST 1, RUN 420/0		
0	0	1.025			1.093			1.086			1.078		
0	.52		.000			.000			.000			.000	
0	.84	.944	.955	.962	.962	1.003	.990	.981	.998	.991	.985	1.004	.992
.03	1.0	.963	.000	.987	.993	.000	1.015	.991	.000	1.013	.995	.000	1.016
.22	1.0	.958	.989		.995	1.005		.995	1.005		.999	1.006	
.40	1.0	.996	.989		1.006	1.011		1.004	1.007		1.007	1.003	
.58	1.0	1.000	1.009		1.009	1.012		1.007	1.011		1.011	1.021	
.76	1.0	1.004	1.008	1.026	1.011	1.012	1.034	1.008	1.012	1.028	1.012	1.015	1.034
.94	1.0	1.030	1.024		1.031	1.058		1.031	1.040		1.036	1.034	
1.12	1.0	.983	.998	1.042	.990	.997	1.038	.987	.997	1.040	.989	1.002	1.045
1.30	1.0	.989	.996		.992	.998		.990	.997		.992	.999	
1.48	1.0	.976	.968		.980	.966		.977	.969		.980	.972	
1.84	1.0	.973			.978			.976			.976		
2.20	1.0	.968	.950	1.046	.970	.958	1.025	.967	.955	1.046	.966	.953	1.049
2.56	1.0	.957			.963			.960			.959		
2.92	1.0	.967	.972		.970	.971		.966	.969		.969	.968	
3.28	1.0	.963			.984			.981			.984		
		TEST 1, RUN 473/0			TEST 1, RUN 448/0			TEST 1, RUN 416/0			TEST 1, RUN 462/0		
0	0	.773			.658			.702			.918		
0	.52		.000			.000			.000			.000	
0	.84	.747	.755	.807	.626	.643	.652	.665	.681	.684	.799	.808	.817
.03	1.0	.918	.000	.937	.913	.000	.933	.913	.000	.936	.930	.000	.934
.22	1.0	.983	.990		.989	.998		.981	.991		.988	.978	
.40	1.0	1.003	.998		1.013	.991		1.006	.999		1.008	1.009	
.58	1.0	1.015	.990		1.017	.998		1.015	.994		1.021	1.027	
.76	1.0	1.017	1.013	1.030	1.026	1.022	1.025	1.017	1.016	1.028	1.032	1.035	1.014
.94	1.0	1.053	1.051		1.055	1.046		1.053	1.046		1.054	1.160	
1.12	1.0	1.007	1.031	1.003	1.009	1.028	1.013	1.003	1.028	1.007	.986	1.018	1.017
1.30	1.0	1.006	1.019		1.005	1.024		1.004	1.022		1.001	1.032	
1.48	1.0	1.003	.991		.996	.993		1.007	.995		.989	.970	
1.84	1.0	.940			.949			.940			.955		
2.20	1.0	.961	.920	1.160	.975	.931	1.145	.968	.922	1.152	.985	.935	1.118
2.56	1.0	.972			.970			.972			.967		
2.92	1.0	.978	1.005		.976	.999		.968	1.008		.984	.992	
3.28	1.0	.991			1.000			.988			.995		

TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
0	0	TEST 1, RUN 417/0			TEST 1, RUN 449/0			TEST 1, RUN 430/0			TEST 1, RUN 418/0		
0	.52	.912	.000		.926	.000		.955	.000		1.082	.000	
0	.84	.802	.809	.817	.806	.809	.824	.848	.856	.865	.894	.908	.907
.03	1.0	.922	.000	.937	.921	.000	.941	.933	.000	.938	.944	.000	.947
.22	1.0	.982	.990		.985	.995		.990	.986		.985	.990	
.40	1.0	1.007	.996		1.008	1.005		1.018	.983		1.010	.993	
.58	1.0	1.015	.999		1.018	.996		1.022	1.032		1.017	1.006	
.76	1.0	1.019	1.017	1.025	1.020	1.019	1.027	1.028	1.023	1.029	1.021	1.016	1.026
.94	1.0	1.050	1.044		1.061	1.044		1.047	1.043		1.052	1.043	
1.12	1.0	1.003	1.030	1.009	1.008	1.030	1.013	1.008	1.025	1.005	1.006	1.026	1.008
1.30	1.0	1.005	1.021		1.008	1.021		1.001	1.023		1.003	1.019	
1.48	1.0	1.006	.995		1.011	.992		.996	.997		1.006	.994	
1.84	1.0	.940			.943			.941			.937		
2.20	1.0	.966	.925	1.146	.968	.927	1.143	.970	.924	1.144	.967	.923	1.145
2.56	1.0	.968			.970			.963			.967		
2.92	1.0	.970	1.001		.980	1.002		.977	.998		.977	1.002	
3.28	1.0	.986			.994			.999			.989		
0	0	TEST 1, RUN 450/0			TEST 1, RUN 451/0			TEST 1, RUN 419/0			TEST 1, RUN 460/0		
0	.52	1.112	.000		1.144	.000		1.180	.000		1.246	.000	
0	.84	.904	.915	.921	.930	.972	.935	.959	.995	.958	.978	.997	.979
.03	1.0	.944	.000	.955	.959	.000	.961	.972	.000	.965	.978	.000	.976
.22	1.0	.986	.992		.984	.991		.987	.998		.987	.989	
.40	1.0	.999	1.001		.997	1.000		1.011	.988		1.005	1.000	
.58	1.0	1.016	.995		1.015	.995		1.017	1.016		1.014	1.017	
.76	1.0	1.017	1.013	1.028	1.015	1.013	1.027	1.024	1.021	1.027	1.023	1.024	1.026
.94	1.0	1.060	1.040		1.067	1.041		1.056	1.044		1.050	1.179	
1.12	1.0	1.006	1.034	1.013	1.007	1.032	1.017	1.007	1.021	1.012	1.003	1.018	1.015
1.30	1.0	1.010	1.020		1.000	1.019		1.002	1.019		1.006	1.020	
1.48	1.0	1.016	.994		1.016	.991		1.003	.993		1.002	.979	
1.84	1.0	.942			.939			.939			.945		
2.20	1.0	.960	.928	1.137	.961	.926	1.133	.969	.924	1.144	.972	.930	1.105
2.56	1.0	.970			.973			.969			.973		
2.92	1.0	.980	1.003		.976	1.001		.976	1.001		.972	.998	
3.28	1.0	.986			.986			.989			.988		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
0 0	TEST 1, RUN 474/0			TEST 1, RUN 415/0			TEST 1, RUN 447/0			TEST 1, RUN 414/0		
0 .52	.717	.000		.764	.000		.807	.000		1.088	.000	
0 .84	.706	.712	.772	.715	.740	.724	.735	.759	.750	.877	.892	.884
.03 1.0	.966	.000	1.074	.964	.000	1.053	.957	.000	1.059	.976	.000	1.065
.22 1.0	1.019	.999		.999	1.011		.999	1.005		1.020	1.010	
.40 1.0	.959	1.012		1.018	.994		1.019	.997		.981	1.005	
.58 1.0	.973	1.035		.966	1.011		.964	1.004		.973	1.046	
.76 1.0	.938	.985	1.058	.972	.991	1.043	.966	.989	1.046	.951	.990	1.061
.94 1.0	.905	.908		.946	.941		.919	.928		.925	.907	
1.12 1.0	.917	.941	1.140	.928	.947	1.127	.928	.946	1.123	.922	.939	1.126
1.30 1.0	.959	.935		.939	.934		.933	.928		.946	.945	
1.48 1.0	.957	.886		.926	.868		.924	.881		.954	.895	
1.64 1.0	.946			.960			.961			.954		
2.20 1.0	.934	.917	.968	.941	.918	.984	.935	.915	.970	.939	.931	.969
2.56 1.0	.974			.937			.934			.965		
2.92 1.0	.976	1.002		.965	1.002		.993	1.002		.984	1.011	
3.28 1.0	.983			1.026			.998			.989		
0 0	TEST 1, RUN 467/0			TEST 1, RUN 446/0			TEST 1, RUN 433/0			TEST 1, RUN 413/0		
0 .52	1.109	.000		1.120	.000		1.233	.000		1.337	.000	
0 .84	.887	.893	.892	.886	.898	.898	.953	.955	.962	.972	.987	.972
.03 1.0	.976	.000	1.087	.973	.000	1.086	.995	.000	1.071	.992	.000	1.078
.22 1.0	1.025	1.001		1.023	1.013		1.009	.983		1.018	1.010	
.40 1.0	.961	1.022		.962	1.007		.980	1.011		1.004	1.001	
.58 1.0	.973	.990		.970	1.027		.968	1.113		.972	1.057	
.76 1.0	.951	.988	1.071	.950	1.000	1.065	.939	.970	1.060	.958	1.007	1.057
.94 1.0	.926	1.091		.924	.898		.907	1.148		.920	.917	
1.12 1.0	.919	.941	1.132	.913	.940	1.132	.926	.948	1.167	.943	.940	1.129
1.30 1.0	.959	.940		.940	.937		.989	.929		.941	.946	
1.48 1.0	.953	.891		.949	.890		.935	.879		.948	.896	
1.64 1.0	.961			.956			.945			.960		
2.20 1.0	.940	.933	.962	.937	.930	.961	.944	.923	.971	.943	.937	.970
2.56 1.0	.970			.966			.968			.956		
2.92 1.0	.990	1.009		.994	1.015		.983	.979		.991	1.010	
3.28 1.0	1.000			.995			.999			.990		

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TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$\theta=60$	$\theta=120$	$\theta=0$	$\theta=60$	$\theta=120$	$\theta=0$	$\theta=60$	$\theta=120$	$\theta=0$	$\theta=60$	$\theta=120$
0 0	TEST 1, RUN 445/0			TEST 1, RUN 412/0			TEST 1, RUN 444/0			TEST 1, RUN 465/0		
0 .52	1.431			1.610			1.671			1.692		
0 .84		.000			.000			.000			.000	
0 .84	.981	.996	.995	1.047	1.064	1.007	1.054	1.060	1.058	1.053	1.092	1.056
.03 1.0	.998	.000	1.085	1.032	.000	1.095	1.023	.000	1.104	1.032	.000	1.102
.22 1.0	1.017	1.006		1.022	2.124		1.029	1.016		1.023	1.006	
.40 1.0	.966	1.004		.965	1.023		.969	1.022		.961	1.017	
.58 1.0	.967	1.022		.981	1.043		.971	.968		.968	.973	
.76 1.0	.939	.984	1.061	2.106	.975	2.141	.936	.949	1.064	.941	.896	1.071
.94 1.0	.924	1.168		.925	.900		.912	.933		.931	1.015	
1.12 1.0	.911	.939	1.131	.928	.953	1.155	.925	.948	1.149	.912	.943	1.132
1.30 1.0	.944	.938		.980	.950		.954	.943		.959	.943	
1.48 1.0	.957	.882		.956	.890		.959	.890		.959	.881	
1.64 1.0	.950			.952			.947			.955		
2.20 1.0	.931	.924	.963	.944	.925	.970	.933	.917	.949	.941	.926	.937
2.56 1.0	.972			.966			.926			.962		
2.92 1.0	.992	1.005		1.000	1.005		1.000	.957		.996	1.011	
3.28 1.0	.993			1.015			1.004			1.005		
0 0	TEST 1, RUN 475/0			TEST 1, RUN 471/0			TEST 1, RUN 440/0			TEST 1, RUN 408/0		
0 .52	.328			1.618			1.873			2.011		
0 .84		.000			.000			.000			3.822	
0 .84	.436	.452	.334	.882	.898	.857	.936	.952	.906	.940	.956	.920
.03 1.0	1.001	.000	.999	1.001	.000	1.032	1.008	.000	1.028	1.005	3.822	1.005
.22 1.0	1.023	.960		1.018	.958		1.025	.961		1.018	.958	
.40 1.0	1.014	.960		1.014	.956		1.022	.960		1.012	.956	
.58 1.0	1.006	.982		1.010	.996		1.018	.990		1.007	.983	
.76 1.0	1.001	.965	1.499	1.005	.965	1.856	1.011	.967	1.582	1.003	.964	1.340
.94 1.0	.911	.914		.936	.915		.935	.915		.919	.910	
1.12 1.0	.993	.988	.937	.999	.987	.936	.999	.990	.939	.994	.984	.937
1.30 1.0	1.027	.999		1.026	.999		1.031	1.003		1.024	.997	
1.48 1.0	.977	.954		.984	.954		.985	.958		.977	.953	
1.64 1.0	1.013			1.015			1.019			1.012		
2.20 1.0	1.009	.985	.731	1.010	.987	.731	1.014	.990	.733	1.009	.984	.731
2.56 1.0	.958			.965			.963			.954		
2.92 1.0	.993	.996		.990	1.003		.992	1.007		.987	1.000	
3.28 1.0	1.020			1.016			1.019			1.019		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\gamma=0$	$\gamma=60$	$\gamma=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 1, RUN 470/0			TEST 1, RUN 409/0			TEST 1, RUN 441/0			TEST 1, RUN 438/1		
0 0	3.319			3.575			3.698			4.118		
0 .52		.000			3.822			.000			.000	
0 .84	1.196	1.201	1.178	1.221	1.244	1.201	1.242	1.258	1.221	1.354	1.360	1.324
.03 1.0	1.032	.000	1.036	1.031	3.822	1.004	1.038	.000	1.021	1.103	.000	.981
.22 1.0	1.008	.958		1.021	.965		1.020	.958		1.076	.973	
.40 1.0	1.005	.955		1.014	.959		1.017	.955		1.073	.842	
.56 1.0	1.002	.999		1.008	.985		1.012	.987		1.019	1.383	
.76 1.0	.998	.963	1.638	1.004	.963	1.266	1.007	.963	1.261	1.008	.961	1.982
.94 1.0	.936	.914		.922	.910		.938	.912		.926	.913	
1.12 1.0	.991	.990	.929	.992	.984	.935	.996	.987	.937	1.000	.982	.931
1.30 1.0	1.027	1.000		1.024	.997		1.025	.999		1.035	1.001	
1.48 1.0	.984	.955		.977	.954		.976	.953		.992	.958	
1.64 1.0	1.017			1.012			1.013			1.022		
2.20 1.0	1.009	.991	.719	1.009	.985	.730	1.008	.988	.733	1.013	.994	.715
2.56 1.0	.965			.954			.954			.966		
2.92 1.0	.990	1.005		.987	1.000		.986	1.004		.998	1.009	
3.28 1.0	1.017			1.019			1.016			1.024		
	TEST 1, RUN 442/0			TEST 1, RUN 409/0			TEST 1, RUN 410/0			TEST 1, RUN 411/0		
0 0	4.799			5.053			3.821			3.820		
0 .52		.000			.000			3.821			3.820	
0 .84	1.399	1.447	1.382	1.446	1.491	1.423	1.439	1.500	1.425	1.581	1.709	1.562
.03 1.0	1.104	.000	1.032	1.136	.000	1.056	1.108	3.821	1.006	1.167	3.820	1.015
.22 1.0	1.023	.961		1.018	.958		1.029	.976		1.037	.983	
.40 1.0	1.020	.958		1.015	.957		1.018	.974		1.023	.969	
.56 1.0	1.015	.991		1.014	1.001		1.009	1.004		1.011	.997	
.76 1.0	1.011	.965	1.704	1.008	.964	1.642	1.006	.962	1.406	1.007	.963	1.074
.94 1.0	.940	.916		.953	.914		.924	.908		.929	.911	
1.12 1.0	1.002	.990	.937	1.000	.991	.923	.994	.982	.933	.993	.984	.936
1.30 1.0	1.029	1.002		1.028	1.001		1.025	.998		1.025	1.000	
1.48 1.0	.985	.958		.965	.958		.977	.954		.974	.956	
1.64 1.0	1.019			1.016			1.011			1.011		
2.20 1.0	1.014	.791	.728	1.010	.993	.717	1.008	.987	.725	1.006	.989	.732
2.56 1.0	.965			.961			.954			.948		
2.92 1.0	.991	1.007		.989	1.008		.986	1.003		.985	1.002	
3.28 1.0	1.018			1.018			1.018			1.019		

TABLE B-2. (Continued)

X/D	P/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 443/0			TEST 1, RUN 468/0			TEST 1, RUN 635/0			TEST 1, RUN 615/0		
0	0	5.356			5.546			.906			.799		
0	.52		.000			.000			.903			.813	
0	.84	1.564	1.682	1.557	1.587	1.075	1.568	.913	.908	.902	.773	.799	.808
.03	1.0	1.167	.000	1.046	1.164	.000	1.070	.941	.931	.943	.867	.864	.886
.22	1.0	1.026	.962		1.027	.965		.966	.965		.939	.939	
.40	1.0	1.023	.960		1.024	.961		.000	.976		.000	.958	
.58	1.0	1.019	.988		1.022	.997		.985	.987		.973	.978	
.76	1.0	1.013	.965	1.204	1.017	.967	1.224	.987	.991	1.015	.981	.985	1.008
.94	1.0	.944	.912		.959	.915		1.020	1.009		1.013	1.003	
1.12	1.0	.997	.991	.939	1.000	1.000	.929	.977	.000	1.030	.974	.000	1.026
1.30	1.0	1.029	1.004		1.035	1.008		.982	.989		.977	.985	
1.48	1.0	.979	.958		.932	.961		.970	.969		.966	.966	
1.64	1.0	1.016			1.022			.000			.000		
2.20	1.0	1.012	.992	.729	1.015	.998	.721	.960	.949	1.046	.964	.953	1.044
2.56	1.0	.955			.956			.954			.957		
2.92	1.0	.987	1.008		.992	1.011		.963	.963		.964	.968	
3.28	1.0	1.018			1.023			.977			.976		
		TEST 1, RUN 616/0			TEST 1, RUN 607/0			TEST 1, RUN 617/0			TEST 1, RUN 634/0		
0	0	.837			.867			.900			.923		
0	.52		.839			.869			.885			.909	
0	.84	.814	.836	.851	.855	.869	.891	.869	.888	.901	.895	.909	.919
.03	1.0	.884	.883	.906	.934	.900	.929	.913	.911	.934	.927	.929	.952
.22	1.0	.945	.946		.956	.959		.957	.957		.966	.969	
.40	1.0	.000	.964		.000	.971		.000	.971		.000	.984	
.58	1.0	.976	.981		.962	.984		.962	.985		.992	.995	
.76	1.0	.983	.986	1.012	.986	.989	1.014	.986	.991	1.015	.994	.999	1.026
.94	1.0	1.002	1.005		1.015	1.007		1.015	1.006		1.015	1.014	
1.12	1.0	.976	.000	1.026	.978	.000	1.029	.977	.000	1.030	.984	.000	1.030
1.30	1.0	.978	.985		.965	.991		.981	.988		.987	.992	
1.48	1.0	.967	.966		.971	.969		.970	.970		.980	.978	
1.64	1.0	.000			.000			.000			.000		
2.20	1.0	.960	.951	1.044	.960	.950	1.044	.965	.952	1.042	.968	.961	1.038
2.56	1.0	.956			.953			.957			.961		
2.92	1.0	.962	.964		.966	.964		.964	.967		.966	.969	
3.28	1.0	.976			.978			.976			.984		

TABLE B-2. (Continued)

X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 1, RUN 618/0			TEST 1, RUN 636/0			TEST 1, RUN 622/0			TEST 1, RUN 621/0		
0 0	.946			.775			.671			.777		
0 .52		.918			.749			.670			.745	
0 .84	.906	.918	.932	.745	.753	.804	.641	.666	.675	.730	.748	.760
.03 1.0	.938	.936	.958	.913	.909	.935	.910	.903	.935	.916	.913	.934
.22 1.0	.971	.971		.982	.983		.980	.973		.989	.987	
.40 1.0	.000	.980		.000	.988		.000	.987		.000	.992	
.58 1.0	.988	.991		1.009	.978		1.008	.984		1.012	.986	
.76 1.0	.991	.993	1.020	1.008	1.000	1.024	1.007	.989	1.023	1.017	1.006	1.028
.94 1.0	1.015	1.010		1.057	1.036		1.048	1.034		1.063	1.037	
1.12 1.0	.979	.000	1.029	1.010	.000	.994	1.009	.000	.998	1.017	.000	1.002
1.30 1.0	.984	.991		1.001	1.012		1.003	1.013		1.004	1.015	
1.48 1.0	.972	.972		1.000	1.001		1.006	.993		1.006	1.000	
1.84 1.0	.000			.000			.000			.000		
2.20 1.0	.961	.954	1.043	.958	.921	1.144	.945	.920	1.141	.961	.924	1.140
2.56 1.0	.955			.963			.961			.965		
2.92 1.0	.965	.963		.968	.999		.963	.993		.973	1.002	
3.28 1.0	.978			.981			.974			.982		
	TEST 1, RUN 620/0			TEST 1, RUN 633/0			TEST 1, RUN 608/0			TEST 1, RUN 619/0		
0 0	.851			.390			.849			.912		
0 .52		.798			.831			.793			.843	
0 .84	.786	.799	.912	.819	.830	.844	.780	.796	.808	.831	.844	.855
.03 1.0	.921	.919	.937	.929	.925	.958	.929	.931	.935	.935	.939	.940
.22 1.0	.995	.989		.984	.990		.986	.996		1.015	.996	
.40 1.0	.000	.993		.000	1.001		.000	.970		.000	.974	
.58 1.0	1.021	.987		1.016	.994		1.013	1.000		1.038	.997	
.76 1.0	1.025	1.009	1.029	1.008	1.007	1.036	1.025	1.019	1.018	1.049	1.017	1.019
.94 1.0	1.069	1.040		1.061	1.041		1.053	1.038		1.075	1.040	
1.12 1.0	1.027	.000	1.002	1.007	.000	1.006	1.013	.000	1.006	1.044	.000	1.002
1.30 1.0	1.001	1.015		1.016	1.023		1.003	1.027		1.004	1.026	
1.48 1.0	1.000	1.003		1.026	1.011		.983	.996		.990	.995	
1.84 1.0	.000			.000			.000			.000		
2.20 1.0	.964	.927	1.141	.963	.934	1.138	.980	.936	1.140	.977	.933	1.138
2.56 1.0	.967			.973			.966			.966		
2.92 1.0	.972	1.002		.986	1.005		.977	.994		.976	.996	
3.28 1.0	.982			.984			.994			.994		



TABLE B-2. (Continued)

X/D	R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
		TEST 1, RUN 637/0			TEST 1, RUN 623/0			TEST 1, RUN 632/0			TEST 1, RUN 624/0		
0	0	.719			.748			.859			.868		
0	.52		.708			.944			.820			.815	
0	.84	.707	.715	.759	.712	.756	.732	.799	.825	.819	.800	.823	.818
.03	1.0	.974	.978	1.074	.965	.977	1.067	.965	.983	1.088	.964	.981	1.078
.22	1.0	1.001	1.015		1.000	1.009		1.013	1.015		1.010	1.016	
.40	1.0	.000	1.007		.000	1.001		.000	1.012		.000	1.005	
.58	1.0	.970	1.007		.973	1.000		.974	1.016		.973	1.010	
.76	1.0	.956	.994	1.050	.967	.988	1.054	.947	.994	1.080	.962	.996	1.059
.94	1.0	.943	.964		.947	.958		.943	.918		.953	.948	
1.12	1.0	.942	.000	1.133	.949	.000	1.134	.937	.000	1.130	.961	.000	1.129
1.30	1.0	.938	.934		.941	.941		.950	.945		.938	.944	
1.48	1.0	.928	.907		.936	.908		.949	.909		.943	.913	
1.64	1.0	.000			.000			.000			.000		
2.20	1.0	.943	.924	.991	.945	.922	.985	.935	.933	.974	.938	.938	.983
2.56	1.0	.939			.938			.968			.953		
2.92	1.0	.998	1.008		1.004	1.011		.999	1.015		1.001	1.007	
3.28	1.0	1.006			.998			.998			.988		
		TEST 1, RUN 612/0			TEST 1, RUN 609/0			TEST 1, RUN 625/0			TEST 1, RUN 626/0		
0	0	.899			.878			.955			1.037		
0	.52		.843			.802			.877			.924	
0	.84	.825	.843	.846	.792	.801	.819	.864	.877	.875	.922	.914	.931
.03	1.0	.971	.981	1.093	.965	.966	1.070	.979	.976	1.083	.986	.963	1.079
.22	1.0	1.014	1.018		1.008	1.004		1.023	.993		1.014	.993	
.40	1.0	.000	1.014		.000	.984		.000	1.007		.000	1.021	
.58	1.0	.973	1.017		.978	1.061		.985	1.026		.984	.989	
.76	1.0	.953	.998	1.081	.964	.996	1.055	.958	.978	1.071	.970	.951	1.066
.94	1.0	.944	.917		.947	.942		.965	.931		.975	.928	
1.12	1.0	.932	.000	1.132	.938	.000	1.127	.951	.000	1.139	1.003	.000	1.146
1.30	1.0	.950	.951		.941	.938		.966	.935		.986	.941	
1.48	1.0	.959	.908		.924	.905		.962	.908		.948	.903	
1.64	1.0	.000			.000			.000			.000		
2.20	1.0	.942	.940	.974	.933	.936	.967	.938	.927	.969	.943	.929	.973
2.56	1.0	.978			.953			.960			.935		
2.92	1.0	1.005	1.017		1.002	1.005		.984	.999		.989	.961	
3.28	1.0	1.000			.996			.991			1.005		



TABLE B-2. (Concluded)

X/D R/R	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$	$\theta=0$	$\theta=60$	$\theta=180$
	TEST 1, RUN 638/0			TEST 1, RUN 630/0			TEST 1, RUN 629/0			TEST 1, RUN 611/0		
0 0	.256			1.369			1.985			2.537		
0 .52		.197			.795			.961			1.101	
0 .84	.165	.268	.246	.815	.785	.828	1.011	.961	.985	1.159	1.092	1.131
.03 1.0	.979	.927	.989	.978	.929	1.003	.984	.939	1.005	1.010	.973	1.012
.22 1.0	.993	.945		.992	.942		.992	.943		.992	.943	
.40 1.0	.000	.948		.000	.945		.000	.946		.000	.945	
.58 1.0	.987	.949		.991	.950		.992	.950		.994	.950	
.76 1.0	.950	.950	.973	.985	.951	.978	.986	.951	.978	.987	.950	.980
.94 1.0	.941	.947		.961	.945		.963	.943		.962	.936	
1.12 1.0	.960	.000	.915	.983	.000	.912	.984	.000	.911	.985	.000	.910
1.30 1.0	1.007	.979		1.009	.983		1.009	.983		1.011	.987	
1.48 1.0	.963	.959		.968	.964		.968	.964		.969	.968	
1.64 1.0	.000			.000			.000			.000		
2.20 1.0	.995	.973	.709	.997	.978	.710	.996	.978	.711	.997	.980	.711
2.56 1.0	.947			.946			.945			.946		
2.92 1.0	.975	.979		.973	.963		.974	.983		.976	.986	
3.28 1.0	.996			.996			.996			.998		
	TEST 1, RUN 628/0			TEST 1, RUN 610/0			TEST 1, RUN 631/0			TEST 1, RUN 627/0		
0 0	2.493			2.521			2.820			2.952		
0 .52		1.075			1.057			1.182			1.180	
0 .84	1.127	1.057	1.101	1.113	1.056	1.096	1.251	1.184	1.216	1.246	1.188	1.216
.03 1.0	.995	.956	1.005	.994	.947	1.004	1.035	.994	1.017	1.033	1.006	1.011
.22 1.0	.993	.943		.994	.944		.991	.943		.993	.944	
.40 1.0	.000	.945		.000	.947		.000	.943		.000	.948	
.58 1.0	.994	.951		.994	.951		.996	.950		.994	.951	
.76 1.0	.967	.950	.980	.967	.951	.983	.988	.947	.977	.987	.950	.982
.94 1.0	.964	.942		.968	.945		.968	.926		.965	.942	
1.12 1.0	.983	.000	.913	.982	.000	.922	.982	.000	.905	.984	.000	.913
1.30 1.0	1.010	.987		1.011	.987		1.012	.989		1.010	.985	
1.48 1.0	.964	.964		.962	.964		.964	.967		.967	.967	
1.64 1.0	.000			.000			.000			.000		
2.20 1.0	.996	.980	.713	.995	.980	.718	.996	.981	1.840	.995	.980	.713
2.56 1.0	.941			.937			.942			.943		
2.92 1.0	.974	.984		.973	.984		.978	.984		.974	.985	
3.28 1.0	.996			.999			1.000			.997		

TABLE B-3. BASE AND BODY SURFACE PRESSURE RATIOS ( $P/P_{\infty}$ ) FOR ET/SRB CLASS

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 61/1							TEST 7, RUN 72/2				
0	0	.986					.989				
.01	.531	.984		.983	.980		.989		.986	.984	
.01	.879		.988					.992			
.01	.931	.983		.983	.978		.990		.986	.984	
.01	.969		.000					.000			
.01	.992	.960		.968	.000		.945		.949	.000	
.083	1.0	.989					.978				
.250	1.0	.988					.985				
.583	1.0	.992					.991				
0	.742		SRB-R	.956 <sup>a</sup>	.963	.958		SRB-R	.951 <sup>a</sup>	.954	.939
0	.742	.958	SRB-L		.960	.963	.954	SRB-L		.939	.952
TEST 7, RUN 61/2							TEST 7, RUN 50/2				
0	0	.985					.987				
.01	.531	.984		.984	.981		.988		.987	.984	
.01	.879		.985					.991			
.01	.931	.980		.980	.976		.988		.987	.979	
.01	.969		.000					.000			
.01	.992	.961		.971	.000		.942		.953	.000	
.083	1.0	.985					.979				
.250	1.0	.988					.985				
.583	1.0	.992					.991				
0	.742		SRB-R	.948 <sup>a</sup>	.959	.948		SRB-R	.952 <sup>a</sup>	.955	.940
0	.742	.957	SRB-L		.946	.959	.955	SRB-L		.940	.953
TEST 7, RUN 65/2							TEST 7, RUN 49/2				
0	0	.988					.988				
.01	.531	.985		.985	.983		.990		.989	.986	
.01	.879		.987					.992			
.01	.931	.985		.984	.979		.989		.989	.981	
.01	.969		.000					.000			
.01	.992	.963		.971	.000		.945		.958	.000	
.083	1.0	.989					.979				
.250	1.0	.989					.985				
.583	1.0	.994					.990				
0	.742		SRB-R	.954 <sup>a</sup>	.958	.947		SRB-R	.970 <sup>a</sup>	.970	.960
0	.742	.958	SRB-L		.946	.958	.970	SRB-L		.960	.970

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 73/4							TEST 7, RUN 40/2				
0	0	.990					.992				
.0	.531	.991		.989	.986		.991		.990	.987	
.0	.879		.993					.996			
.0	.931	.991		.989	.978		.991		.993	.984	
.0	.969		.000					.000			
.0	.992	.948		.954	.000		.950		.959	.000	
.033	1.0	.981					.980				
.250	1.0	.986					.987				
.583	1.0	.990					.991				
0	.742		SRB-R	.975 <sup>a</sup>	.976	.966		SRB-R	.981 <sup>a</sup>	.981	.975
0	.742	.976	SRB-L		.966	.975	.981	SRB-L		.972	.981
TEST 7, RUN 86/2							TEST 7, RUN 60/1				
0	0	.992					.959				
.0	.531	.993		.991	.988		.955		.946	.939	
.0	.879		.995					.959			
.0	.931	.992		.990	.983		.957		.946	.917	
.0	.969		.000					.000			
.0	.992	.948		.954	.000		.874		.834	.000	
.083	1.0	.982					.948				
.250	1.0	.987					.961				
.583	1.0	.992					.972				
0	.742		SRB-R	.986 <sup>a</sup>	.963	.974		SRB-R	.854 <sup>a</sup>	.865	.864
0	.742	.987	SRB-L		.974	.983	.852	SRB-L		.861	.860
TEST 7, RUN 60/2							TEST 7, RUN 64/2				
0	0	.981					.978				
.0	.531	.981		.973	.964		.976		.966	.959	
.0	.879		.963					.976			
.0	.931	.980		.975	.946		.974		.967	.941	
.0	.969		.000					.000			
.0	.992	.903		.872	.000		.898		.858	.000	
.083	1.0	.970					.962				
.250	1.0	.974					.968				
.583	1.0	.982					.976				
0	.742		SRB-R	.881 <sup>a</sup>	.912	.871		SRB-R	.904 <sup>a</sup>	.927	.893
0	.742	.900	SRB-L		.863	.901	.918	SRB-L		.885	.915

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 51/2							TEST 7, RUN 71/2				
0	0	.993					.994				
.0	.531	.993		.985	.976		.994		.984	.976	
.0	.879		.997					.997			
.0	.931	.996		.988	.963		.996		.986	.000	
.0	.969		.000					.000			
.0	.992	.904		.863	.000		.904		.849	.000	
.083	1.0	.964					.965				
.250	1.0	.971					.973				
.583	1.0	.979					.982				
0	.742		SRB-R	.960 <sup>a</sup>	.971	.942		SRB-R	.960 <sup>a</sup>	.977	.949
0	.742	.965	SRB-L		.963	.935	.970	SRB-L		.968	.942
TEST 7, RUN 48/2							TEST 7, RUN 74/2				
0	0	1.014					1.019				
.0	.531	1.017		1.010	.999		1.020		1.012	1.002	
.0	.879		1.020					1.024			
.0	.931	1.019		1.011	.992		1.026		1.016	.998	
.0	.969		.000					.000			
.0	.992	.937		.903	.000		.944		.891	.000	
.083	1.0	.982					.989				
.250	1.0	.985					.990				
.583	1.0	.990					.993				
0	.742		SRB-R	1.020 <sup>a</sup>	1.028	1.010		SRB-R	1.033 <sup>a</sup>	1.042	1.023
0	.742	1.024	SRB-L		1.003	1.024	1.035	SRB-L		1.016	1.036
TEST 7, RUN 41/2							TEST 7, RUN 85/2				
0	0	1.031					1.037				
.0	.531	1.034		1.027	1.017		1.041		1.032	1.022	
.0	.879		1.034					1.044			
.0	.931	1.031		1.027	1.013		1.044		1.036	1.023	
.0	.969		.000					.000			
.0	.992	.962		.921	.000		.961		.919	.000	
.083	1.0	1.000					1.004				
.250	1.0	.994					1.004				
.583	1.0	.994					1.002				
0	.742		SRB-R	1.060 <sup>a</sup>	1.067	1.053		SRB-R	1.072 <sup>a</sup>	1.076	1.062
0	.742	1.059	SRB-L		1.046	1.062	1.071	SRB-L		1.058	1.072

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 62/1							TEST 7, RUN 62/2				
0	0	.804					.866				
.0	.531	.802		.803	.793		.864		.862	.858	
.0	.879		.811					.871			
.0	.931	.801		.802	.761		.864		.862	.842	
.0	.969		.000					.000			
.0	.992	.684		.639	.000		.761		.707	.000	
.083	1.0	.901					.901				
.250	1.0	.924					.921				
.583	1.0	.939					.935		<sup>a</sup>		
0	.742		SRB-R	.664	.667	.664		SRB-R	.793	.808	.783
0	.742	.666	SRB-L		.660	.679	.817	SRB-L		.767	.811
TEST 7, RUN 63/2							TEST 7, RUN 52/2				
0	0	.877					.937				
.0	.531	.875		.872	.867		.938		.938	.931	
.0	.879		.883					.946			
.0	.931	.877		.873	.850		.942		.938	.913	
.0	.969		.000					.000			
.0	.992	.773		.712	.000		.839		.776	.000	
.083	1.0	.907					.917				
.250	1.0	.926					.926				
.583	1.0	.938		<sup>a</sup>			.935		<sup>a</sup>		
0	.742		SRB-R	.820	.836	.811		SRB-R	.961	.965	.961
0	.742	.837	SRB-L		.791	.833	.970	SRB-L		.940	.972
TEST 7, RUN 70/8							TEST 7, RUN 47/2				
0	0	.938					.992				
.0	.531	.940		.938	.929		1.002		1.004	.994	
.0	.879		.950					1.010			
.0	.931	.946		.938	.910		1.007		1.004	.986	
.0	.969		.000					.000			
.0	.992	.836		.769	.000		.932		.862	.000	
.083	1.0	.921					.953				
.250	1.0	.931					.941				
.583	1.0	.938		<sup>a</sup>			.936		<sup>a</sup>		
0	.742		SRB-R	.969	.972	.974		SRB-R	1.047	1.055	1.046
0	.742	.979	SRB-L		.949	.981	1.055	SRB-L		1.039	1.060



TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
		TEST 7, RUN 75/2					TEST 7, RUN 59/4				
0	0	1.010					1.043				
.0	.531	1.018		1.018	1.008		1.051		1.045	1.036	
.0	.879		1.028					1.054			
.0	.931	1.026		1.019	.998		1.052		1.044	1.033	
.0	.969		.000					.000			
.0	.992	.955		.870	.000		.995		.906	.000	
.083	1.0	.967					.957				
.250	1.0	.951					.964				
.583	1.0	.942		<sup>a</sup>			.941		<sup>a</sup>		
0	.742		SRB-R	1.073	1.090	1.072		SRB-R	1.100	1.130	1.104
0	.742	1.080	SRB-L		1.071	1.090	1.102	SRB-L		1.103	1.121
		TEST 7, RUN 84/2					TEST 7, RUN 56/1				
0	0	1.047					.791				
.0	.531	1.055		1.049	1.037		.783		.771	.777	
.0	.879		1.058					.786			
.0	.931	1.057		1.051	1.035		.779		.772	.760	
.0	.969		.000					.000			
.0	.992	.975		.926	.000		.668		.642	.000	
.083	1.0	.989					.924				
.250	1.0	.965					.939				
.583	1.0	.945		<sup>a</sup>			.956				
0	.742		SRB-R	1.113	1.133	1.115		SRB-R	.565 <sup>a</sup>	.540	.557
0	.742	1.115	SRB-L		1.103	1.129	.557	SRB-L		.545	.543
		TEST 7, RUN 56/2					TEST 7, RUN 66/2				
0	0	.854					.858				
.0	.531	.846		.837	.841		.848		.839	.845	
.0	.879		.848					.851			
.0	.931	.846		.839	.832		.844		.841	.836	
.0	.969		.000					.000			
.0	.992	.740		.664	.000		.733		.663	.000	
.083	1.0	.925					.924				
.250	1.0	.941					.939				
.583	1.0	.953		<sup>a</sup>			.959				
0	.742		SRB-R	.774	.794	.779		SRB-R	.795 <sup>a</sup>	.797	.782
0	.742	.795	SRB-L		.755	.798	.806	SRB-L		.765	.801

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 53/2							TEST 7, RUN 69/2				
0	0	.942					.946				
.0	.531	.938		.932	.934		.933		.931	.936	
.0	.679		.941					.937			
.0	.931	.935		.934	.920		.935		.935	.927	
.0	.969		.000					.000			
.0	.992	.841		.734	.000		.833		.727	.000	
.083	1.0	.938					.939				
.250	1.0	.944					.946				
.583	1.0	.960					.958				
0	.742		SRB-R	.984 <sup>a</sup>	.976	.974		SRB-R	.996 <sup>a</sup>	.990	.991
0	.742	.984	SRB-L		.958	.982	.997	SRB-L		.972	.994
TEST 7, RUN 46/2							TEST 7, RUN 76/2				
0	0	1.008					1.017				
.0	.531	1.013		1.009	1.006		1.020		1.016	1.013	
.0	.679		1.016					1.029			
.0	.931	1.013		1.008	.996		1.029		1.020	1.009	
.0	.969		.000					.000			
.0	.992	.939		.830	.000		.955		.830	.000	
.083	1.0	.967					.973				
.250	1.0	.954					.958				
.583	1.0	.962					.959				
0	.742		SRB-R	1.077 <sup>a</sup>	1.062	1.076		SRB-R	1.104 <sup>a</sup>	1.110	1.098
0	.742	1.079	SRB-L		1.067	1.081	1.109	SRB-L		1.105	1.106
TEST 7, RUN 43/3							TEST 7, RUN 79/3				
0	0	1.046					1.063				
.0	.531	1.056		1.055	1.043		1.073		1.070	1.065	
.0	.679		1.064					1.078			
.0	.931	1.058		1.051	1.040		1.079		1.070	1.063	
.0	.969		.000					.000			
.0	.992	1.003		.883	.000		1.030		.895	.000	
.083	1.0	.991					1.009				
.250	1.0	.961					.973				
.583	1.0	.958					.961				
0	.742		SRB-R	1.122 <sup>a</sup>	1.145	1.120		SRB-R	1.156 <sup>a</sup>	1.185	1.158
0	.742	1.132	SRB-L		1.123	1.142	1.166	SRB-L		1.161	1.179

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
		TEST 7, RUN 55/2					TEST 7, RUN 55/3				
0	0	.787					.853				
.0	.531	.780		.778	.769		.851		.849	.838	
.0	.879		.786					.857			
.0	.931	.777		.772	.734		.850		.848	.812	
.0	.969		.000					.000			
.0	.992	.675		.651	.000		.757		.673	.000	
.083	1.0	.933					.932				
.250	1.0	.955					.953				
.583	1.0	.965		<sup>a</sup>			.965		<sup>a</sup>		
0	.742		SRB-R	.517	.497	.512		SRB-R	.763	.801	.773
0	.742	.506	SRB-L		.499	.506	.806	SRB-L		.756	.815
		TEST 7, RUN 67/2					TEST 7, RUN 68/2				
0	0	.868					.939				
.0	.531	.866		.860	.851		.944		.940	.926	
.0	.879		.872					.953			
.0	.931	.866		.862	.823		.948		.944	.900	
.0	.969		.000					.000			
.0	.992	.772		.679	.000		.862		.737	.000	
.083	1.0	.939					.953				
.250	1.0	.959					.962				
.583	1.0	.969		<sup>a</sup>			.972		<sup>a</sup>		
0	.742		SRB-R	.829	.832	.814		SRB-R	1.002	.998	.999
0	.742	.840	SRB-L		1.055	.842	1.004	SRB-L		.974	1.005
		TEST 7, RUN 54/2					TEST 7, RUN 45/3				
0	0	.948					1.009				
.0	.531	.952		.950	.934		1.023		1.027	1.007	
.0	.879		.962					1.036			
.0	.931	.957		.953	.916		1.032		1.028	1.006	
.0	.969		.000					.000			
.0	.992	.875		.753	.000		.969		.842	.000	
.083	1.0	.945					.976				
.250	1.0	.953					.964				
.583	1.0	.963		<sup>a</sup>			.968		<sup>a</sup>		
0	.742		SRB-R	1.013	1.012	1.008		SRB-R	1.103	1.117	1.109
0	.742	1.014	SRB-L		.986	1.008	1.110	SRB-L		1.101	1.121

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 77/3							TEST 7, RUN 44/2				
0	0	1.013					1.048				
.01	.531	1.035		1.036	1.017		1.076		1.068	1.046	
.01	.879		1.047					1.087			
.01	.931	1.044		1.039	1.015		1.082		1.068	1.041	
.01	.969		.000					.000			
.01	.992	.988		.850	.000		1.037		.889	.000	
.083	1.0	.986					1.005				
.250	1.0	.971					.973				
.583	1.0	.971					.964				
0	.742		SRB-R	1.128 <sup>a</sup>	1.143	1.131		SRB-R	1.156 <sup>a</sup>	1.194	1.159
0	.742	1.140	SRB-L		1.136	1.144	1.173	SRB-L		1.163	1.192
TEST 7, RUN 78/2							TEST 7, RUN 164/3				
0	0	1.055					.615				
.01	.531	1.086		1.083	1.056		.596		.588	.612	
.01	.879		1.096					.580			
.01	.931	1.099		1.083	1.059		.589		.601	.619	
.01	.969		.000					.578			
.01	.992	1.061		.903	.000		.617		.630	.619	
.083	1.0	1.023					.966				
.250	1.0	.985					.985				
.583	1.0	.973					1.042				
0	.742		SRB-R	1.180 <sup>a</sup>	1.215	1.183		SRB-R	.358 <sup>a</sup>	.362	.370
0	.742	1.201	SRB-L		1.194	1.216	.345	SRB-L		.349	.345
TEST 7, RUN 164/4							TEST 7, RUN 163/2				
0	0	.837					1.036				
.01	.531	.814		.815	.836		.990		.997	1.026	
.01	.879		.806					.994			
.01	.931	.803		.808	.840		.995		.997	1.036	
.01	.969		.801					.967			
.01	.992	.839		.690	.791		.921		.850	.954	
.083	1.0	.956					.961				
.250	1.0	.974					.974				
.583	1.0	1.044					1.056				
0	.742		SRB-R	.961 <sup>a</sup>	.943	.970		SRB-R	1.011 <sup>a</sup>	1.085	1.018
0	.742	.955	SRB-L		.956	.957	1.031	SRB-L		1.011	1.103

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 162/2							TEST 7, RUN 161/3				
0	0	1.140					1.110				
.0	.531	1.145		1.135	1.135		1.032		1.085	1.079	
.0	.879		1.145					1.110			
.0	.931	1.149		1.131	1.129		1.130		1.086	1.089	
.0	.969		1.137					1.096			
.0	.992	1.071		.962	1.071		1.055		.917	1.012	
.083	1.0	.979					.984				
.250	1.0	.978					.988				
.583	1.0	1.046		<sup>a</sup>			1.058		<sup>a</sup>		
0	.742		SRB-R	1.122	1.249	1.125		SRB-R	1.155	1.338	1.161
0	.742	1.164	SRB-L		1.117	1.271	1.158	SRB-L		1.094	1.258
TEST 7, RUN 109/2							TEST 7, RUN 114/2				
0	0	.989					.987				
.0	.531	.989		.983	.981		.987		.983	.980	
.0	.879		.989					.988			
.0	.931	.987		.980	.972		.986		.979	.971	
.0	.969		.976					.975			
.0	.992	.941		.944	.962		.942		.944	.963	
.083	1.0	.977					.975				
.250	1.0	.985					.984				
.583	1.0	.000		<sup>a</sup>			.000		<sup>a</sup>		
0	.797		SRB-R	.956	.955	.953		SRB-R	.941	.948	.924
0	.797	.958	SRB-L		.953	.952	.948	SRB-L		.930	.947
TEST 7, RUN 121/2							TEST 7, RUN 109/3				
0	0	.990					.992				
.0	.531	.989		.984	.983		.992		.988	.985	
.0	.879		.990					.993			
.0	.931	.990		.983	.977		.992		.986	.978	
.0	.969		.978					.981			
.0	.992	.947		.949	.967		.950		.953	.971	
.083	1.0	.977					.979				
.250	1.0	.985					.986				
.583	1.0	.000		<sup>a</sup>			.000		<sup>a</sup>		
0	.797		SRB-R	.971	.973	.958		SRB-R	.989	.993	.983
0	.797	.972	SRB-L		.961	.972	.991	SRB-L		.977	.991



TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 110/1							TEST 7, RUN 113/2				
0	0	.967					.989				
.01	.531	.965		.955	.947		.990		.980	.972	
.01	.879		.967					.994			
.01	.931	.967		.956	.927		.991		.981	.959	
.01	.969		.951					.979			
.01	.992	.860		.847	.891		.893		.880	.927	
.083	1.0	.937					.952				
.250	1.0	.956					.968				
.583	1.0	.000					.000				
0	.797		SRB-R	.856 <sup>a</sup>	.868	.847		SRB-R	.911 <sup>a</sup>	.940	.882
0	.797	.853	SRB-L		.850	.863	.929	SRB-L		.886	.932
TEST 7, RUN 111/2							TEST 7, RUN 110/2				
0	0	1.022					1.047				
.01	.531	1.025		1.019	1.009		1.054		1.045	1.033	
.01	.879		1.031					1.062			
.01	.931	1.029		1.024	1.009		1.057		1.050	1.037	
.01	.969		1.020					1.050			
.01	.992	.943		.936	.982		.979		.975	1.015	
.083	1.0	.982					1.007				
.250	1.0	.987					1.010				
.583	1.0	.000					.000				
0	.797		SRB-R	1.025 <sup>a</sup>	1.034	1.011		SRB-R	1.086 <sup>a</sup>	1.090	1.080
0	.797	1.028	SRB-L		1.030	1.007	1.087	SRB-L		1.072	1.087
TEST 7, RUN 122/2							TEST 7, RUN 115/2				
0	0	.820					.920				
.01	.531	.815		.804	.809		.919		.909	.905	
.01	.879		.811					.916			
.01	.931	.816		.803	.782		.917		.907	.892	
.01	.969		.794					.907			
.01	.992	.693		.660	.735		.808		.779	.854	
.083	1.0	.874					.886				
.250	1.0	.904					.908				
.583	1.0	.000					.000				
0	.797		SRB-R	.700 <sup>a</sup>	.703	.690		SRB-R	.893 <sup>a</sup>	.914	.886
0	.797	.698	SRB-L		.689	.698	.894	SRB-L		.872	.900

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
		TEST 7, RUN 120/2					TEST 7, RUN 122/3				
0	0	1.003					1.053				
.01	.531	1.014		.995	.981		1.052		1.044	1.037	
.01	.879		1.020					1.053			
.01	.931	1.021		1.004	.986		1.055		1.044	1.031	
.01	.969		1.014					1.047			
.01	.992	.939		.892	.965		.984		.937	1.007	
.083	1.0	.937					.982				
.250	1.0	.928					.965				
.583	1.0	.000					.000				
0	.797		SRB-R	1.069	1.079	1.074		SRB-R	1.137	1.178	1.137
0	.797	1.059	SRB-L		1.054	1.068	1.132	SRB-L		1.172	1.164
		TEST 7, RUN 119/1					TEST 7, RUN 116/2				
0	0	.777					.894				
.01	.531	.766		.753	.762		.893		.881	.884	
.01	.879		.756					.888			
.01	.931	.768		.747	.718		.890		.879	.867	
.01	.969		.734					.875			
.01	.992	.664		.641	.719		.792		.712	.893	
.083	1.0	.907					.917				
.250	1.0	.935					.938				
.583	1.0	.000					.000				
0	.797		SRB-R	.622	.614	.620		SRB-R	.895	.905	.891
0	.797	.614	SRB-L		.612	.610	.879	SRB-L		.857	.890
		TEST 7, RUN 119/2					TEST 7, RUN 118/2				
0	0	1.004					.755				
.01	.531	1.022		1.002	.980		.735		.721	.727	
.01	.879		1.029					.722			
.01	.931	1.031		1.011	.989		.734		.712	.684	
.01	.969		1.022					.709			
.01	.992	.947		.854	.966		.651		.646	.709	
.083	1.0	.959					.923				
.250	1.0	.955					.955				
.583	1.0	.000					.000				
0	.797		SRB-R	1.083	1.103	1.090		SRB-R	.538	.520	.549
0	.797	1.068	SRB-L		1.067	1.092	.539	SRB-L		.538	.531

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 117/2		TEST 7, RUN 118/3									
0	0	.897					1.002				
.0	.531	.893		.880	.877		1.025		1.009	.977	
.0	.879		.887					1.029			
.0	.931	.892		.876	.856		1.030		1.016	.989	
.0	.969		.877					1.025			
.0	.992	.811		.727	.832		.957		.855	.964	
.083	1.0	.926					.963				
.250	1.0	.953					.961				
.583	1.0	.000					.000				
0	.797		SRB-R	.926 <sup>a</sup>	.923	.921		SRB-R	1.084 <sup>a</sup>	1.101	1.093
0	.797	.899	SRB-L		.861	.907	1.068	SRB-L		1.068	1.086
TEST 7, RUN 123/2		TEST 7, RUN 170/4									
0	0	1.071					.632				
.0	.531	1.085		1.067	1.044		.612		.606	.627	
.0	.879		1.090					.600			
.0	.931	1.089		1.070	1.044		.605		.611	.642	
.0	.969		1.086					.611			
.0	.992	1.032		.910	1.012		.605		.616	.629	
.083	1.0	1.009					.923				
.250	1.0	.982					.956				
.583	1.0	.000					1.038				
0	.797		SRB-R	1.169 <sup>a</sup>	1.232	1.161		SRB-R	.356 <sup>a</sup>	.337	.352
0	.797	1.174	SRB-L		1.157	1.211	.356	SRB-L		.349	.348
TEST 7, RUN 172/2		TEST 7, RUN 171/2									
0	0	1.010					1.129				
.0	.531	.971		.979	.997		1.192		1.171	1.119	
.0	.879		.971					1.199			
.0	.931	.963		.965	1.001		1.187		1.170	1.118	
.0	.969		.960					1.190			
.0	.992	.921		.849	.947		1.118		.985	1.120	
.083	1.0	.941					.986				
.250	1.0	.964					.963				
.583	1.0	1.033					1.034				
0	.797		SRB-R	.865 <sup>a</sup>	.914	.880		SRB-R	1.040 <sup>a</sup>	1.187	1.026
0	.797	.832	SRB-L		.842	.934	1.041	SRB-L		.987	1.206

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 170/5											
0	0	1.204									
.0	.531	1.247		1.189	1.152						
.0	.879		1.246								
.0	.931	1.262		1.194	1.137						
.0	.969		1.239								
.0	.992	1.213		.993	1.122						
.083	1.0	1.025									
.250	1.0	.958									
.583	1.0	1.022									
0	.797		SRB-R	1.208	1.412	1.196					
0	.797	1.299	SRB-L		1.180	1.425					
TEST 7, RUN 126/1											
0	0	.985					TEST 7, RUN 137/2				
.0	.531	.962		.983	.981		.991				
.0	.879		.984				.989		.989	.986	
.0	.931	.981		.981	.974			.993			
.0	.969		.979				.989		.988	.976	
.0	.992	.960		.965	.976			.983			
.083	1.0	.979					.949		.954	.973	
.250	1.0	.987					.977				
.583	1.0	.991					.986				
0	.843		SRB-R	.952 <sup>a</sup>	.968	.962	.991				
0	.843	.954	SRB-L		.961	.966		SRB-R	.959 <sup>a</sup>	.958	.953
TEST 7, RUN 126/2											
0	0	.987					TEST 7, RUN 138/3				
.0	.531	.984		.985	.983		.991				
.0	.879		.986				.990		.992	.988	
.0	.931	.983		.984	.979			.993			
.0	.969		.981				.990		.989	.977	
.0	.992	.963		.970	.981			.984			
.083	1.0	.981					.950		.956	.975	
.250	1.0	.987					.976				
.583	1.0	.991					.984				
0	.843		SRB-R	.959 <sup>a</sup>	.956	.953	.990				
0	.843	.955	SRB-L		.955	.954		SRB-R	.973 <sup>a</sup>	.974	.969
TEST 7, RUN 138/3											
							.968	SRB-L		.970	.972

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 148/1							TEST 7, RUN 129/2				
0	0	.963					.982				
.001	.531	.959		.955	.942		.978		.978	.965	
.001	.679		.967					.984			
.001	.931	.963		.959	.911		.979		.978	.945	
.001	.969		.955					.971			
.001	.992	.858		.842	.880		.898		.900	.926	
.083	1.0	.928					.951				
.250	1.0	.951					.969				
.583	1.0	.970					.981				
0	.843		SRB-R	.848 <sup>a</sup>	.865	.849		SRB-R	.873 <sup>a</sup>	.897	.868
0	.843	.859	SRB-L		.843	.862	.884	SRB-L		.862	.891
TEST 7, RUN 136/2							TEST 7, RUN 139/2				
0	0	1.001					1.034				
.001	.531	.999		1.000	.989		1.036		1.034	1.023	
.001	.879		1.006					1.042			
.001	.931	1.000		1.001	.968		1.039		1.036	1.009	
.001	.969		.996					1.033			
.001	.992	.913		.915	.943		.961		.961	.983	
.083	1.0	.959					.989				
.250	1.0	.974					.997				
.583	1.0	.983					.999				
0	.843		SRB-R	.963 <sup>a</sup>	.972	.956		SRB-R	1.044 <sup>a</sup>	1.044	1.044
0	.843	.963	SRB-L		.951	.967	1.042	SRB-L		1.038	1.046
TEST 7, RUN 147/1							TEST 7, RUN 130/2				
0	0	.814					.874				
.001	.531	.809		.788	.793		.869		.858	.864	
.001	.879		.812					.869			
.001	.931	.809		.795	.785		.869		.860	.865	
.001	.969		.793					.855			
.001	.992	.686		.646	.759		.771		.746	.819	
.083	1.0	.875					.876				
.250	1.0	.912					.913				
.583	1.0	.925					.927				
0	.843		SRB-R	.689 <sup>a</sup>	.698	.689		SRB-R	.765 <sup>a</sup>	.788	.791
0	.843	.692	SRB-L		.661	.697	.778	SRB-L		.755	.786



TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 135/2							TEST 7, RUN 140/2				
0	0	.955					1.034				
.0	.531	.956		.957	.951		1.040		1.035	1.023	
.0	.879		.963					1.045			
.0	.931	.958		.959	.940		1.044		1.039	1.019	
.0	.969		.955					1.040			
.0	.992	.861		.836	.887		.981		.942	.973	
.083	1.0	.898					.960				
.250	1.0	.919					.943				
.583	1.0	.924		<sup>a</sup>			.927		<sup>a</sup>		
0	.843		SRB-R	.957	.970	.990		SRB-R	1.081	1.106	1.089
0	.843	.959	SRB-L		.947	.974	1.093	SRB-L		1.081	1.102
TEST 7, RUN 147/2							TEST 7, RUN 146/1				
0	0	1.062					.784				
.0	.531	1.065		1.055	1.047		.766		.765	.759	
.0	.879		1.070					.772			
.0	.931	1.067		1.060	1.042		.762		.765	.738	
.0	.969		1.065					.754			
.0	.992	1.010		.970	.998		.671		.643	.792	
.083	1.0	.991					.903				
.250	1.0	.968					.938				
.583	1.0	.935		<sup>a</sup>			.856		<sup>a</sup>		
0	.843		SRB-R	1.140	1.178	1.140		SRB-R	.632	.623	.631
0	.843	1.149	SRB-L		1.122	1.152	.622	SRB-L		.619	.623
TEST 7, RUN 131/2							TEST 7, RUN 134/3				
0	0	.846					.944				
.0	.531	.835		.828	.827		.944		.942	.937	
.0	.879		.838					.949			
.0	.931	.830		.829	.810		.944		.945	.928	
.0	.969		.820					.939			
.0	.992	.729		.670	.825		.847		.771	.896	
.083	1.0	.911					.921				
.250	1.0	.947					.946				
.583	1.0	.956		<sup>a</sup>			.949		<sup>a</sup>		
0	.843		SRB-R	.738	.751	.743		SRB-R	.952	.963	.980
0	.843	.729	SRB-L		.712	.752	.935	SRB-L		.937	.957

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
		TEST 7, RUN 142/2					TEST 7, RUN 146/2				
0	0	1.040					1.068				
.0	.531	1.048		1.034	1.019		1.066		1.058	1.049	
.0	.879		1.054					1.071			
.0	.931	1.053		1.037	1.013		1.077		1.061	1.037	
.0	.969		1.050					1.069			
.0	.992	.988		.876	.956		1.021		.906	.983	
.083	1.0	.972					.998				
.250	1.0	.963					.973				
.583	1.0	.956					.957				
0	.843		SRB-R	1.106	1.149	1.119		SRB-R	1.167	1.228	1.171
0	.843	1.115	SRB-L		1.106	1.143	1.182	SRB-L		1.148	1.203
		TEST 7, RUN 145/1					TEST 7, RUN 132/2				
0	0	.761					.834				
.0	.531	.726		.719	.731		.794		.791	.809	
.0	.879		.724					.799			
.0	.931	.711		.710	.711		.789		.792	.805	
.0	.969		.710					.780			
.0	.992	.650		.649	.796		.708		.666	.828	
.083	1.0	.922					.921				
.250	1.0	.957					.962				
.583	1.0	.965					.966				
0	.843		SRB-R	.566	.534	.559		SRB-R	.745	.749	.758
0	.843	.552	SRB-L		.569	.545	.736	SRB-L		.723	.756
		TEST 7, RUN 133/2					TEST 7, RUN 141/2				
0	0	.947					1.044				
.0	.531	.931		.937	.938		1.055		1.044	1.026	
.0	.879		.943					1.065			
.0	.931	.932		.941	.929		1.062		1.048	1.024	
.0	.969		.927					1.061			
.0	.992	.840		.767	.897		.997		.881	.957	
.083	1.0	.932					.976				
.250	1.0	.961					.970				
.583	1.0	.965					.964				
0	.843		SRB-R	.966	.967	.971		SRB-R	1.105	1.146	1.114
0	.843	.953	SRB-L		.955	.973	1.121	SRB-L		1.116	1.141

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 7, RUN 145/2							TEST 7, RUN 154/1				
0	0	1.087					.601				
.0	.531	1.096		1.080	1.062		.580		.566	.584	
.0	.879		1.101					.569			
.0	.931	1.102		1.083	1.054		.570		.561	.587	
.0	.969		1.102					.570			
.0	.992	1.055		.921	.986		.636		.634	.668	
.083	1.0	1.011					.921				
.250	1.0	.981					.968				
.583	1.0	.969					1.047				
0	.843		SRB-R	1.162	1.229	1.159		SRB-R	.319	.323	.323
0	.843	1.199	SRB-L		1.165	1.204	.317	SRB-L		.349	.332
TEST 7, RUN 156/4							TEST 7, RUN 155/2				
0	0	.842					1.060				
.0	.531	.823		.823	.841		1.028		1.027	1.059	
.0	.879		.812					1.039			
.0	.931	.819		.808	.860		1.040		1.045	1.085	
.0	.969		.809					1.029			
.0	.992	.754		.687	.791		.969		.902	1.002	
.083	1.0	.917					.919				
.250	1.0	.968					.961				
.583	1.0	1.047					1.034				
0	.843		SRB-R	.681	.646	.650		SRB-R	.882	.967	.848
0	.843	.615	SRB-L		.635	.672	.672	SRB-L		.850	.966
TEST 7, RUN 154/2											
0	0	1.100									
.0	.531	1.090		1.097	1.090						
.0	.879		1.130								
.0	.931	1.146		1.105	1.087						
.0	.969		1.131								
.0	.992	1.063		.947	1.020						
.083	1.0	.954									
.250	1.0	.976									
.583	1.0	1.047									
0	.843		SRB-R	1.090	1.201	1.082					
0	.843	1.146	SRB-L		1.093	1.241					

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 8, RUN 1						TEST 8, RUN 14					
0	0	.980					1.002				
.01	.531	.977		.984	.935		.985		.995	.996	
.01	.879		.990					.995			
.01	.931	.988		.985	.968		.996		.993	.994	
.01	.969		.958					.956			
.01	.992	.925		.922	.968		.931		.935	.972	
.017	1.0	.952					.959				
.052	1.0	.965					.973				
.121	1.0	.972		<sup>a</sup>			.983		<sup>a</sup>		
0	.833		SRB-R	.951	.958	.950		SRB-R	.954	.978	.945
0	.833	.945	SRB-L		.945	.951	.976	SRB-L		.949	.973
TEST 8, RUN 31						TEST 8, RUN 20					
0	0	1.007					1.019				
.01	.531	1.012		1.010	1.005		1.016		1.014	1.018	
.01	.879		1.013					1.015			
.01	.931	1.016		1.005	.997		1.015		1.010	1.016	
.01	.969		.987					.980			
.01	.992	.960		.957	.960		.955		.967	.980	
.017	1.0	.982					.986				
.052	1.0	.990					.994				
.121	1.0	.994		<sup>a</sup>			.998		<sup>a</sup>		
0	.833		SRB-R	.990	.989	.963		SRB-R	1.013	1.017	.990
0	.833	.992	SRB-L		.962	.988	1.015	SRB-L		.997	1.014
TEST 8, RUN 33						TEST 8, RUN 21					
0	0	1.026					1.041				
.01	.531	1.030		1.025	1.024		1.038		1.037	1.045	
.01	.879		1.025					1.040			
.01	.931	1.033		1.041	1.013		1.043		1.023	1.039	
.01	.969		1.008					1.019			
.01	.992	.983		.985	.959		.996		.999	.980	
.017	1.0	.998					1.015				
.052	1.0	1.006					1.023				
.121	1.0	1.006		<sup>a</sup>			1.020		<sup>a</sup>		
0	.833		SRB-R	1.021	1.013	1.003		SRB-R	1.061	1.061	1.056
0	.833	1.018	SRB-L		1.002	1.017	1.059	SRB-L		1.052	1.059

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 8, RUN 2		TEST 8, RUN 7									
0	0	.928					.985				
.01	.531	.936		.932	.927		1.006		1.009	.962	
.01	.879		.957					1.012			
.01	.931	.957		.946	.879		1.013		1.015	.940	
.01	.969		.936					.996			
.01	.992	.790		.690	.849		.866		.860	.898	
.017	1.0	.844					.901				
.052	1.0	.886					.936				
.121	1.0	.918		<sup>a</sup>			.966				
0	.833		SRB-R	.835	.849	.832		SRB-R	.946 <sup>a</sup>	.937	.875
0	.833	.847	SRB-L		.839	.853	.943	SRB-L		.860	.938
TEST 8, RUN 24		TEST 8, RUN 6									
0	0	1.012					1.045				
.01	.531	1.041		1.026	1.009		1.068		1.049	1.030	
.01	.879		1.039					1.068			
.01	.931	1.044		1.047	.991		1.070		1.064	1.038	
.01	.969		1.022					1.048			
.01	.992	.913		.886	.808		.950		.924	.850	
.017	1.0	.940					.970				
.052	1.0	.964					.991				
.121	1.0	.980		<sup>a</sup>			1.003		<sup>a</sup>		
0	.833		SRB-R	1.026	1.010	.974		SRB-R	1.108	1.092	1.073
0	.833	1.020	SRB-L		.955	1.015	1.099	SRB-L		1.055	1.091
TEST 8, RUN 25		TEST 8, RUN 8									
0	0	1.074					1.087				
.01	.531	1.093		1.078	1.074		1.136		1.100	1.089	
.01	.879		1.090					1.100			
.01	.931	1.097		1.102	1.055		1.111		1.115	1.104	
.01	.969		1.072					1.085			
.01	.992	.990		.992	.849		.995		1.015	.883	
.017	1.0	1.009					1.013				
.052	1.0	1.024					1.030				
.121	1.0	1.026					1.037		<sup>a</sup>		
0	.833		SRB-R	1.142 <sup>a</sup>	1.127	1.113		SRB-R	1.166	1.157	1.137
0	.833	1.135	SRB-L		1.106	1.131	1.156	SRB-L		1.130	1.150



TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
0	0	TEST 8, RUN 17					TEST 8, RUN 15				
.01	.531	.779					.927				
.01	.879	.812		.791	.767		.971		.967	.934	
.01	.931		.809					.981			
.01	.969	.822		.839	.756		.980		.989	.938	
.01	.992		.765					.971			
.017	1.0	.604		.570	.789		.867		.768	.757	
.052	1.0	.837					.863				
.121	1.0	.880					.902				
0	.833	.893		<sup>a</sup>			.925		<sup>a</sup>		
0	.833		SRB-R	.733	.755	.728		SRB-R	.943	.938	.891
		.720	SRB-L		.712	.735	.926	SRB-L		.853	.924
0	0	TEST 8, RUN 27					TEST 8, RUN 17				
.01	.531	.968					1.079				
.01	.879	1.013		.996	.972		1.077		1.096	1.125	
.01	.931		1.008					1.088			
.01	.969	1.014		1.022	.967		1.094		1.132	1.114	
.01	.992		1.004					1.091			
.017	1.0	.920		.832	.750		1.025		1.010	.801	
.052	1.0	.863					.997				
.121	1.0	.907					.996				
0	.833	.919		<sup>a</sup>			.975		<sup>a</sup>		
0	.833		SRB-R	1.039	1.035	1.003		SRB-R	1.163	1.172	1.162
		1.033	SRB-L		1.012	1.022	1.171	SRB-L		1.157	1.170
0	0	TEST 8, RUN 28					TEST 8, RUN 19				
.01	.531	1.144					1.200				
.01	.879	1.137		1.125	1.129		1.208		1.194	1.224	
.01	.931		1.138					1.198			
.01	.969	1.156		1.172	1.124		1.209		1.225	1.205	
.01	.992		1.138					1.204			
.017	1.0	1.111		1.047	.766		1.177		1.148	.825	
.052	1.0	1.102					1.192				
.121	1.0	1.093					1.179				
0	.833	1.059		<sup>a</sup>			1.143		<sup>a</sup>		
0	.833		SRB-R	1.239	1.255	1.233		SRB-R	1.283	1.306	1.273
		1.238	SRB-L		1.217	1.231	1.325	SRB-L		1.295	1.312

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 6, RUN 5							TEST 8, RUN 5				
0	0	.790					.980				
.01	.531	.831		.800	.805		1.005		.998	.977	
.01	.879		.808					1.008			
.01	.931	.818		.811	.784		1.035		1.016	.961	
.01	.969		.747					1.001			
.01	.992	.585		.579	.748		.877		.774	.755	
.017	1.0	.851					.902				
.052	1.0	.896					.947				
.121	1.0	.908					.965				
0	.833		SRB-R	.647 <sup>a</sup>	.661	.636		SRB-R	1.082	1.075	1.074
0	.833	.650	SRB-L		.623	.654	1.080	SRB-L		1.054	1.075
TEST 8, RUN 4							TEST 8, RUN 10				
0	0	.757					.866				
.01	.531	.753		.764	.769		.855		.873	.850	
.01	.879		.790					.868			
.01	.931	.791		.774	.747		.856		.870	.827	
.01	.969		.692					.779			
.01	.992	.592		.600	.730		.598		.619	.720	
.017	1.0	.872					.907				
.052	1.0	.921					.950				
.121	1.0	.949					.977				
0	.833		SRB-R	.634 <sup>a</sup>	.653	.620		SRB-R	.834 <sup>a</sup>	.834	.770
0	.833	.623	SRB-L		.612	.632	.829	SRB-L		.732	.821
TEST 6, RUN 22							TEST 8, RUN 9				
0	0	.898					.992				
.01	.531	.908		.898	.897		1.004		1.019	.985	
.01	.879		.918					1.029			
.01	.931	.909		.930	.875		1.025		1.032	.961	
.01	.969		.824					.990			
.01	.992	.634		.638	.740		.795		.693	.727	
.017	1.0	.918					.937				
.052	1.0	.968					.987				
.121	1.0	.997					1.017				
0	.833		SRB-R	.923 <sup>a</sup>	.899	.855		SRB-R	1.080	1.080	1.087
0	.833	.894	SRB-L		.846	.892	1.068	SRB-L		1.046	1.080

TABLE B-3. (Continued)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 8, RUN 23							TEST 8, RUN 11				
0	0	1.057					1.182				
.01	.531	1.095		1.076	1.062		1.131		1.185	1.173	
.01	.879		1.096					1.202			
.01	.931	1.105		1.114	1.044		1.210		1.196	1.127	
.01	.969		1.092					1.203			
.01	.992	.994		.832	.739		1.172		.965	.715	
.017	1.0	.998					1.141				
.052	1.0	1.018					1.142				
.121	1.0	1.025					1.109				
0	.833		SRB-R	1.170 <sup>a</sup>	1.197	1.171		SRB-R	1.296 <sup>a</sup>	1.348	1.293
0	.833	1.173	SRB-L		1.156	1.196	1.355	SRB-L		1.301	1.383
TEST 8, RUN 3							TEST 8, RUN 12				
0	0	.712					.850				
.01	.531	.680		.709	.762		.852		.839	.869	
.01	.879		.718					.854			
.01	.931	.682		.712	.717		.834		.848	.825	
.01	.969		.615					.765			
.01	.992	.599		.627	.657		.622		.640	.616	
.017	1.0	.892					.913				
.052	1.0	.942					.964				
.121	1.0	.974					.984				
0	.833		SRB-R	.564 <sup>a</sup>	.574	.549		SRB-R	.907 <sup>a</sup>	.908	.877
0	.833	.557	SRB-L		.555	.569	.935	SRB-L		.919	.929
TEST 8, RUN 30							TEST 8, RUN 26				
0	0	.844					.886				
.01	.531	.828		.820	.844		.886		.868	.882	
.01	.879		.827					.872			
.01	.931	.828		.837	.808		.873		.905	.838	
.01	.969		.716					.787			
.01	.992	.614		.638	.678		.624		.641	.675	
.017	1.0	.915					.927				
.052	1.0	.959					.970				
.121	1.0	.983					.987				
0	.833		SRB-R	.899 <sup>a</sup>	.886	.845		SRB-R	.977 <sup>a</sup>	.962	.955
0	.833	.913	SRB-L		.872	.910	.952	SRB-L		.921	.947

TABLE B-3. (Concluded)

X/D	R/R	$\theta=0$	$=15$	$=45$	$=90$	$=270$	$\theta=0$	$=15$	$=45$	$=90$	$=270$
TEST 6, RUN 32							TEST 8, RUN 13				
0	0	.941					.951				
.0	.531	.936		.925	.951		.960		.929	.985	
.0	.879		.928					.963			
.0	.931	.933		.972	.923		.957		.929	1.007	
.0	.969		.867					.923			
.0	.992	.690		.660	.687		.707		.660	.649	
.017	1.0	.926					.921				
.052	1.0	.970					.973				
.121	1.0	.987					.994				
0	.833		SRB-R	1.036 <sup>a</sup>	1.016	1.006		SRB-R	1.094 <sup>a</sup>	1.081	1.091
0	.833	1.007	SRB-L		1.001	1.007	1.072	SRB-L		1.080	1.080
TEST 8, RUN 29							TEST 8, RUN 10				
0	0	.994					1.133				
.0	.531	.998		.984	1.008		1.143		1.163	1.245	
.0	.879		.999					1.156			
.0	.931	1.006		.990	.995		1.173		1.190	1.221	
.0	.969		.971					1.165			
.0	.992	.792		.736	.685		1.112		.916	.690	
.017	1.0	.918					1.073				
.052	1.0	.974					1.074				
.121	1.0	.991					1.042				
0	.833		SRB-R	1.112 <sup>a</sup>	1.128	1.103		SRB-R	1.244 <sup>a</sup>	1.327	1.220
0	.833	1.126	SRB-L		1.101	1.126	1.306	SRB-L		1.276	1.376

<sup>a</sup>  
 $\theta = -45$

TABLE B-4. BASE AND BODY SURFACE PRESSURE RATIOS ( $P/P_{\infty}$ ) FOR SRB-ALONE CLASS

(A) S3F1													
X/D	R/R	$\theta=0$	$\theta=90$	$\theta=270$	$\theta=0$	$\theta=90$	$\theta=270$	$\theta=0$	$\theta=90$	$\theta=270$	$\theta=0$	$\theta=90$	$\theta=270$
		TEST10, RUN 104/0			TEST10, RUN 105/0			TEST10, RUN 106/0			TEST10, RUN 107/0		
0	.81	.921	.922	.922	.933	.933	.933	.945	.945	.945	.953	.953	.953
.121	1.0	.970			.975			.981			.984		
.360	1.0	1.001			1.004			1.007			1.009		
.599	1.0	1.026			1.027			1.029			1.030		
.759	1.0	1.024			1.025			1.026			1.027		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	1.004			1.005			1.007			1.007		
		TEST10, RUN 103/0			TEST10, RUN 102/0			TEST10, RUN 101/0			TEST10, RUN 100/0		
0	.81	.775	.774	.775	.831	.831	.832	.879	.880	.881	.956	.956	.957
.121	1.0	.957			.966			.983			1.020		
.360	1.0	1.053			1.056			1.066			1.086		
.599	1.0	1.124			1.124			1.130			1.142		
.759	1.0	1.120			1.119			1.124			1.135		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	1.039			1.040			1.044			1.054		
		TEST10, RUN 96/0			TEST10, RUN 97/0			TEST10, RUN 98/0			TEST10, RUN 99/1		
0	.81	.645	.632	.642	.757	.745	.757	.860	.844	.861	1.009	.995	1.013
.121	1.0	1.165			1.162			1.162			1.170		
.360	1.0	1.267			1.263			1.262			1.262		
.599	1.0	1.313			1.311			1.300			1.298		
.759	1.0	1.269			1.272			1.262			1.256		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	1.006			1.016			1.007			1.009		
		TEST10, RUN 92/0			TEST10, RUN 94/1			TEST10, RUN 95/0			TEST10, RUN 88/2		
0	.81	.671	.641	.656	.924	.903	.915	1.045	1.027	1.034	.759	.718	.748
.121	1.0	1.291			1.286			1.291			1.419		
.360	1.0	1.348			1.334			1.336			1.416		
.599	1.0	1.366			1.351			1.354			1.439		
.759	1.0	1.219			1.232			1.224			.981		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	1.017			.997			.977			.964		



TABLE B-4. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$
0	.81	TEST10, RUN 89/1			TEST10, RUN 111/9			TEST10, RUN 108/1			TEST10, RUN 109/0		
.121	1.0	.906	.865	.900	.422	.372	.350	.599	.571	.581	.804	.777	.817
.360	1.0	1.419			1.831			1.835			1.835		
.599	1.0	1.412			1.770			1.777			1.781		
.759	1.0	1.432			1.629			1.623			1.608		
1.002	1.0	.984			1.141			1.129			1.110		
1.246	1.0	.000			.000			.000			.000		
		.960			1.121			1.110			1.091		
0	.81	TEST10, RUN 110/0			TEST10, RUN 111/0			TEST10, RUN 47/9			TEST10, RUN 50/0		
.121	1.0	1.064	1.048	1.096	1.365	1.355	1.403	.954	.952	.953	.913	.912	.913
.360	1.0	1.851			1.880			.981			.965		
.599	1.0	1.792			1.817			1.006			.999		
.759	1.0	1.648			1.698			1.027			1.023		
1.002	1.0	1.224			1.333			1.027			1.023		
1.246	1.0	.000			.000			.000			.000		
		1.191			1.296			1.005			1.004		
0	.81	TEST10, RUN 49/0			TEST10, RUN 48/0			TEST10, RUN 47/1			TEST10, RUN 51/9		
.121	1.0	.921	.920	.921	.932	.931	.931	.943	.942	.942	.862	.850	.850
.360	1.0	.968			.972			.977			.976		
.599	1.0	1.000			1.002			1.004			1.062		
.759	1.0	1.023			1.024			1.026			1.131		
1.002	1.0	1.023			1.024			1.025			1.123		
1.246	1.0	.000			.000			.000			.000		
		1.004			1.005			1.006			1.036		
0	.81	TEST10, RUN 51/0			TEST10, RUN 52/0			TEST10, RUN 53/0			TEST10, RUN 54/0		
.121	1.0	.745	.739	.739	.803	.798	.798	.881	.877	.877	.945	.942	.942
.360	1.0	.953			.961			.983			1.013		
.599	1.0	1.050			1.053			1.064			1.078		
.759	1.0	1.117			1.121			1.126			1.134		
1.002	1.0	1.109			1.112			1.117			1.123		
1.246	1.0	.000			.000			.000			.000		
		1.031			1.032			1.038			1.044		

TABLE B-4. (Continued)

(A) CONTINUED.

X/D	R/R	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$
		TEST10, RUN 55/9			TEST10, RUN 58/0			TEST10, RUN 57/0			TEST10, RUN 56/0		
0	.81	.723	.703	.706	.672	.659	.660	.783	.769	.774	.931	.915	.922
.121	1.0	1.178			1.173			1.171			1.176		
.360	1.0	1.260			1.273			1.270			1.269		
.599	1.0	1.328			1.312			1.308			1.303		
.759	1.0	1.269			1.258			1.254			1.249		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	.994			.996			.996			.998		
		TEST10, RUN 55/0			TEST10, RUN 59/6			TEST10, RUN 62/0			TEST10, RUN 61/1		
0	.81	1.086	1.073	1.085	.551	.527	.514	.712	.683	.676	.852	.825	.828
.121	1.0	1.197			1.317			1.311			1.312		
.360	1.0	1.274			1.370			1.361			1.353		
.599	1.0	1.304			1.367			1.373			1.365		
.759	1.0	1.248			1.163			1.207			1.220		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	1.003			1.010			1.008			.984		
		TEST10, RUN 60/0			TEST10, RUN 59/0			TEST10, RUN 63/8			TEST10, RUN 63/0		
0	.81	1.004	.979	.985	1.149	1.128	1.134	.455	.441	.419	.673	.636	.637
.121	1.0	1.300			1.313			1.450			1.455		
.360	1.0	1.348			1.351			1.446			1.445		
.599	1.0	1.356			1.359			1.463			1.454		
.759	1.0	1.213			1.216			.947			.969		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	1.005			1.008			.927			.925		
		TEST10, RUN 64/0			TEST10, RUN 65/0			TEST10, RUN 66/0			TEST10, RUN 46/9		
0	.81	.814	.760	.763	.952	.915	.920	1.156	1.114	1.125	.283	.272	.238
.121	1.0	1.455			1.456			1.468			1.804		
.360	1.0	1.444			1.441			1.449			1.793		
.599	1.0	1.448			1.443			1.445			1.601		
.759	1.0	.978			.987			.996			.955		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	.931			.931			.937			.969		

TABLE B-4. (Continued)

(A) CONCLUDED.													
X/D	R/R	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$
		TEST10, RUN 46/0			TEST10, RUN 45/0			TEST10, RUN 44/0			TEST10, RUN 43/0		
0	.81	.761	.731	.725	1.029	.983	1.002	1.303	1.246	1.283	1.388	1.326	1.368
.121	1.0	1.804			1.811			1.824			1.854		
.360	1.0	1.789			1.791			1.804			1.820		
.599	1.0	1.581			1.583			1.581			1.650		
.759	1.0	1.017			1.054			1.075			1.183		
1.002	1.0	.000			.000			.000			.000		
1.246	1.0	1.008			1.030			1.045			1.130		

TABLE B-4. (Continued)

(B) S3F2													
X/D	R/R	$\theta=0$	$\theta=90$	$\theta=270$	$\theta=0$	$\theta=90$	$\theta=270$	$\theta=0$	$\theta=90$	$\theta=270$	$\theta=0$	$\theta=90$	$\theta=270$
0	.81	TEST10, RUN 27/9			TEST10, RUN 27/0			TEST10, RUN 28/0			TEST10, RUN 29/0		
		.947	.945	.945	.886	.885	.886	.894	.893	.894	.907	.906	.906
.109	1.0	1.013			.994			.995			1.000		
.190	1.0	1.033			1.020			1.021			1.024		
.271	1.0	1.050			1.042			1.042			1.045		
.385	1.0	1.049			1.042			1.042			1.044		
.466	1.0	1.039			1.031			1.032			1.034		
.547	1.0	1.031			1.024			1.024			1.026		
0	.81	TEST10, RUN 30/0			TEST10, RUN 23/9			TEST10, RUN 26/0			TEST10, RUN 25/0		
		.920	.919	.920	.836	.833	.834	.632	.620	.634	.707	.696	.709
.109	1.0	1.005			1.079			1.087			1.091		
.190	1.0	1.027			1.137			1.152			1.154		
.271	1.0	1.046			1.186			1.199			1.201		
.385	1.0	1.046			1.160			1.190			1.191		
.466	1.0	1.036			1.150			1.162			1.164		
.547	1.0	1.028			1.124			1.135			1.137		
0	.81	TEST10, RUN 24/1			TEST10, RUN 23/0			TEST10, RUN 19/9			TEST10, RUN 19/0		
		.808	.800	.812	.888	.883	.889	.677	.664	.671	.608	.596	.605
.109	1.0	1.099			1.099			1.392			1.375		
.190	1.0	1.159			1.152			1.439			1.418		
.271	1.0	1.201			1.194			1.448			1.425		
.385	1.0	1.192			1.184			1.406			1.385		
.466	1.0	1.166			1.158			1.376			1.357		
.547	1.0	1.140			1.133			1.336			1.319		
0	.81	TEST10, RUN 20/0			TEST10, RUN 21/0			TEST10, RUN 22/0			TEST10, RUN 15/9		
		.717	.705	.717	.862	.848	.863	1.012	.998	1.016	.496	.472	.489
.109	1.0	1.367			1.372			1.376			1.599		
.190	1.0	1.408			1.410			1.409			1.622		
.271	1.0	1.414			1.412			1.408			1.601		
.385	1.0	1.374			1.372			1.367			1.533		
.466	1.0	1.346			1.346			1.342			1.482		
.547	1.0	1.310			1.310			1.307			1.392		

TABLE B-4. (Concluded)

(B) CONCLUDED.

X/D	R/R	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$	$\theta=0$	$=90$	$=270$
0	.81	TEST10, RUN 18/0			TEST10, RUN 17/0			TEST10, RUN 16/0			TEST10, RUN 15/0		
.109	1.0	.643	.606	.632	.785	.748	.776	.943	.912	.939	1.102	1.076	1.098
.190	1.0	1.578			1.580			1.569			1.565		
.271	1.0	1.597			1.596			1.582			1.575		
.385	1.0	1.575			1.573			1.557			1.547		
.466	1.0	1.510			1.506			1.492			1.482		
.547	1.0	1.463			1.460			1.449			1.441		
		1.383			1.384			1.378			1.373		
0	.81	TEST10, RUN 11/1			TEST10, RUN 12/0			TEST10, RUN 13/0			TEST10, RUN 14/0		
.109	1.0	.574	.549	.561	.722	.667	.712	.866	.825	.863	1.072	1.044	1.078
.190	1.0	1.968			1.984			2.006			1.947		
.271	1.0	1.913			1.924			1.931			1.881		
.385	1.0	1.796			1.805			1.808			1.759		
.466	1.0	1.563			1.572			1.565			1.551		
.547	1.0	1.339			1.354			1.321			1.379		
		.970			.983			.983			1.026		
0	.81	TEST10, RUN 31/8			TEST10, RUN 34/0			TEST10, RUN 33/1			TEST10, RUN 31/1		
.109	1.0	.315	.280	.264	.756	.697	.725	1.031	.949	1.011	1.326	1.241	1.313
.190	1.0	3.104			3.262			3.238			3.109		
.271	1.0	2.751			2.691			2.670			2.683		
.385	1.0	2.451			2.346			2.314			2.306		
.466	1.0	1.239			1.294			1.317			1.328		
.547	1.0	.931			.992			1.013			1.042		
		.930			.932			.936			.942		
0	.81	TEST10, RUN 32/1											
.109	1.0	1.407	1.322	1.398									
.190	1.0	3.316											
.271	1.0	2.706											
.385	1.0	2.323											
.466	1.0	1.324											
.547	1.0	1.040											
		.942											



TABLE B-5. NOZZLE WALL PRESSURES FOR CLASSIC GEOMETRY

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 1 RUN 356/0 N 3 , G1 47 26.45	TEST 1 RUN 323/0 N 3 , G1 47 26.15	TEST 1 RUN 357/0 N 3 , G1 47 26.92	TEST 1 RUN 354/0 N 3 , G1 47 26.82	TEST 1 RUN 322/0 N 3 , G1 47 26.75	TEST 1 RUN 353/0 N 3 , G1 47 27.30	TEST 1 RUN 358/0 N 3 , G1 47 27.21	TEST 1 RUN 321/0 N 3 , G1 47 27.14
TEST 1 RUN 359/0 N 3 , G1 47 27.40	TEST 1 RUN 352/0 N 3 , G1 47 27.52	TEST 1 RUN 320/0 N 3 , G1 47 27.40	TEST 1 RUN 363/0 N 3 , G1 47 26.38	TEST 1 RUN 316/0 N 3 , G1 47 26.26	TEST 1 RUN 362/0 N 3 , G1 47 26.91	TEST 1 RUN 349/0 N 3 , G1 47 26.69	TEST 1 RUN 317/0 N 3 , G1 47 26.77
TEST 1 RUN 350/0 N 3 , G1 47 27.30	TEST 1 RUN 329/0 N 3 , G1 47 27.17	TEST 1 RUN 361/0 N 3 , G1 47 27.20	TEST 1 RUN 328/0 N 3 , G1 47 27.36	TEST 1 RUN 318/0 N 3 , G1 47 27.20	TEST 1 RUN 351/0 N 3 , G1 47 27.70	TEST 1 RUN 360/0 N 3 , G1 47 27.55	TEST 1 RUN 319/0 N 3 , G1 47 27.62
TEST 1 RUN 347/0 N 3 , G1 47 26.25	TEST 1 RUN 364/0 N 3 , G1 47 26.38	TEST 1 RUN 315/0 N 3 , G1 47 26.18	TEST 1 RUN 365/0 N 3 , G1 47 26.85	TEST 1 RUN 346/0 N 3 , G1 47 26.64	TEST 1 RUN 314/0 N 3 , G1 47 26.70	TEST 1 RUN 345/0 N 3 , G1 47 27.21	TEST 1 RUN 366/0 N 3 , G1 47 27.17
TEST 1 RUN 313/0 N 3 , G1 47 27.14	TEST 1 RUN 344/0 N 3 , G1 47 27.49	TEST 1 RUN 367/0 N 3 , G1 47 27.40	TEST 1 RUN 312/0 N 3 , G1 47 27.17	TEST 1 RUN 376/0 N 3 , G1 47 26.38	TEST 1 RUN 340/0 N 3 , G1 47 26.51	TEST 1 RUN 308/1 N 3 , G1 47 26.55	TEST 1 RUN 370/0 N 3 , G1 47 26.89
TEST 1 RUN 341/0 N 3 , G1 47 27.02	TEST 1 RUN 379/0 N 3 , G1 47 27.09	TEST 1 RUN 337/0 N 3 , G1 47 26.92	TEST 1 RUN 309/0 N 3 , G1 47 26.91	TEST 1 RUN 342/0 N 3 , G1 47 27.14	TEST 1 RUN 380/0 N 3 , G1 47 27.17	TEST 1 RUN 310/0 N 3 , G1 47 27.43	TEST 1 RUN 343/0 N 3 , G1 47 27.42
TEST 1 RUN 381/0 N 3 , G1 47 27.54	TEST 1 RUN 311/0 N 3 , G1 47 27.40	TEST 1 RUN 377/2 N 3 , G1 47 27.50	TEST 1 RUN 336/0 N 3 , G1 47 27.54	TEST 1 RUN 155/0 N 4 , G1 47 94.34	TEST 1 RUN 154/0 N 4 , G1 47 93.46	TEST 1 RUN 195/0 N 4 , G1 47 92.59	TEST 1 RUN 194/0 N 4 , G1 47 93.46

TABLE B-5. (Continued)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 1 RUN 115/0 N 4 , G1 47 91.74	TEST 1 RUN 193/0 N 4 , G1 47 92.45	TEST 1 RUN 156/0 N 4 , G1 47 92.31	TEST 1 RUN 196/0 N 4 , G1 47 92.88	TEST 1 RUN 116/0 N 4 , G1 47 92.02	TEST 1 RUN 153/0 N 4 , G1 47 92.74	TEST 1 RUN 152/0 N 4 , G1 47 93.17	TEST 1 RUN 117/0 N 4 , G1 47 93.60
TEST 1 RUN 197/0 N 4 , G1 47 93.17	TEST 1 RUN 157/0 N 4 , G1 47 93.75	TEST 1 RUN 192/0 N 4 , G1 47 93.60	TEST 1 RUN 198/0 N 4 , G1 47 93.90	TEST 1 RUN 151/0 N 4 , G1 47 94.94	TEST 1 RUN 118/0 N 4 , G1 47 94.94	TEST 1 RUN 191/0 N 4 , G1 47 94.94	TEST 1 RUN 158/0 N 4 , G1 47 95.39
TEST 1 RUN 150/0 N 4 , G1 47 96.46	TEST 1 RUN 190/0 N 4 , G1 47 95.69	TEST 1 RUN 159/0 N 4 , G1 47 97.09	TEST 1 RUN 119/0 N 4 , G1 47 96.15	TEST 1 RUN 199/0 N 4 , G1 47 96.15	TEST 1 RUN 145/0 N 4 , G1 47 93.31	TEST 1 RUN 164/0 N 4 , G1 47 94.34	TEST 1 RUN 204/0 N 4 , G1 47 94.34
TEST 1 RUN 124/0 N 4 , G1 47 90.91	TEST 1 RUN 185/0 N 4 , G1 47 94.04	TEST 1 RUN 123/0 N 4 , G1 47 91.05	TEST 1 RUN 203/0 N 4 , G1 47 93.02	TEST 1 RUN 163/0 N 4 , G1 47 92.59	TEST 1 RUN 146/0 N 4 , G1 47 92.59	TEST 1 RUN 186/0 N 4 , G1 47 92.59	TEST 1 RUN 162/0 N 4 , G1 47 93.60
TEST 1 RUN 147/0 N 4 , G1 47 93.90	TEST 1 RUN 122/0 N 4 , G1 47 93.02	TEST 1 RUN 202/0 N 4 , G1 47 93.31	TEST 1 RUN 187/0 N 4 , G1 47 93.46	TEST 1 RUN 161/0 N 4 , G1 47 94.64	TEST 1 RUN 201/0 N 4 , G1 47 94.19	TEST 1 RUN 148/0 N 4 , G1 47 95.24	TEST 1 RUN 121/0 N 4 , G1 47 95.39
TEST 1 RUN 186/0 N 4 , G1 47 94.79	TEST 1 RUN 120/0 N 4 , G1 47 95.24	TEST 1 RUN 149/0 N 4 , G1 47 97.09	TEST 1 RUN 200/0 N 4 , G1 47 95.24	TEST 1 RUN 160/0 N 4 , G1 47 95.15	TEST 1 RUN 189/0 N 4 , G1 47 96.00	TEST 1 RUN 205/0 N 4 , G1 47 92.59	TEST 1 RUN 165/0 N 4 , G1 47 90.91
TEST 1 RUN 125/0 N 4 , G1 47 89.29	TEST 1 RUN 206/0 N 4 , G1 47 92.74	TEST 1 RUN 166/0 N 4 , G1 47 91.32	TEST 1 RUN 126/0 N 4 , G1 47 91.19	TEST 1 RUN 207/0 N 4 , G1 47 92.59	TEST 1 RUN 167/0 N 4 , G1 47 92.24	TEST 1 RUN 127/0 N 4 , G1 47 92.59	TEST 1 RUN 208/0 N 4 , G1 47 94.04

TABLE B-5. (Continued)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 1 RUN 168/0 N 4 , G1 47 94.19	TEST 1 RUN 128/0 N 4 , G1 47 94.64	TEST 1 RUN 209/0 N 4 , G1 47 95.24	TEST 1 RUN 129/0 N 4 , G1 47 96.15	TEST 1 RUN 169/0 N 4 , G1 47 96.15	TEST 1 RUN 134/0 N 4 , G1 47 91.88	TEST 1 RUN 210/0 N 4 , G1 47 94.94	TEST 1 RUN 133/0 N 4 , G1 47 90.77
TEST 1 RUN 211/0 N 4 , G1 47 92.59	TEST 1 RUN 132/0 N 4 , G1 47 92.74	TEST 1 RUN 212/2 N 4 , G1 47 92.17	TEST 1 RUN 131/0 N 4 , G1 47 93.60	TEST 1 RUN 213/0 N 4 , G1 47 94.04	TEST 1 RUN 214/0 N 4 , G1 47 95.39	TEST 1 RUN 130/0 N 4 , G1 47 96.46	TEST 1 RUN 709/0 N 5 , G1 47 30.83
TEST 1 RUN 702/0 N 5 , G1 47 31.22	TEST 1 RUN 712/0 N 5 , G1 47 35.65	TEST 1 RUN 708/0 N 5 , G1 47 43.61	TEST 1 RUN 710/0 N 5 , G1 47 47.89	TEST 1 RUN 703/0 N 5 , G1 47 48.19	TEST 1 RUN 701/0 N 5 , G1 47 52.08	TEST 1 RUN 704/0 N 5 , G1 47 59.64	TEST 1 RUN 715/0 N 5 , G1 47 59.23
TEST 1 RUN 707/0 N 5 , G1 47 59.64	TEST 1 RUN 713/0 N 5 , G1 47 62.83	TEST 1 RUN 714/0 N 5 , G1 47 65.72	TEST 1 RUN 706/0 N 5 , G1 47 66.15	TEST 1 RUN 711/0 N 5 , G1 47 66.30	TEST 1 RUN 705/0 N 5 , G1 47 66.96	TEST 1 RUN 542/0 N 1A, G2 47 52.08	TEST 1 RUN 541/0 N 1A, G2 47 48.62
TEST 1 RUN 519/0 N 1A, G2 47 49.71	TEST 1 RUN 540/0 N 1A, G2 47 48.70	TEST 1 RUN 550/0 N 1A, G2 47 47.47	TEST 1 RUN 518/0 N 1A, G2 47 50.68	TEST 1 RUN 539/0 N 1A, G2 47 48.70	TEST 1 RUN 538/0 N 1A, G2 47 48.31	TEST 1 RUN 533/0 N 1A, G2 47 48.74	TEST 1 RUN 534/0 N 1A, G2 47 48.58
TEST 1 RUN 535/0 N 1A, G2 47 48.54	TEST 1 RUN 520/0 N 1A, G2 47 49.98	TEST 1 RUN 517/0 N 1A, G2 47 50.98	TEST 1 RUN 549/0 N 1A, G2 47 47.28	TEST 1 RUN 536/0 N 1A, G2 47 48.50	TEST 1 RUN 537/0 N 1A, G2 47 49.02	TEST 1 RUN 532/0 N 1A, G2 47 49.19	TEST 1 RUN 531/0 N 1A, G2 47 48.50
TEST 1 RUN 516/0 N 1A, G2 47 50.93	TEST 1 RUN 521/0 N 1A, G2 47 49.97	TEST 1 RUN 530/0 N 1A, G2 47 48.27	TEST 1 RUN 548/0 N 1A, G2 47 47.58	TEST 1 RUN 529/0 N 1A, G2 47 48.35	TEST 1 RUN 528/0 N 1A, G2 47 48.66	TEST 1 RUN 523/1 N 1A, G2 47 49.46	TEST 1 RUN 524/0 N 1A, G2 47 47.85

TABLE B-5. (Continued)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 1 RUN 522/0 N 1A, G2 47 49.75	TEST 1 RUN 515/0 N 1A, G2 47 50.80	TEST 1 RUN 546/0 N 1A, G2 47 48.43	TEST 1 RUN 547/0 N 1A, G2 47 49.30	TEST 1 RUN 525/0 N 1A, G2 47 48.90	TEST 1 RUN 526/0 N 1A, G2 47 48.74	TEST 1 RUN 527/0 N 1A, G2 47 49.14	
TEST 2 RUN 32/0 N 1C, G3 2 7.37 3 29.98 4 83.19	TEST 2 RUN 133/0 N 1C, G3 2 7.04 3 27.50 4 78.49	TEST 2 RUN 33/0 N 1C, G3 2 7.24 3 28.05 4 77.52	TEST 2 RUN 35/0 N 1C, G3 2 7.32 3 28.27 4 75.70	TEST 2 RUN 34/0 N 1C, G3 2 7.55 3 28.78 4 76.69	TEST 2 RUN 136/0 N 1C, G3 2 6.99 3 28.13 4 73.86	TEST 2 RUN 137/0 N 1C, G3 2 7.12 3 27.29 4 77.52	TEST 2 RUN 138/0 N 1C, G3 2 7.25 3 28.23 4 76.98
TEST 2 RUN 237/0 N 1C, G3 2 6.80 3 25.88 4 72.05	TEST 2 RUN 238/0 N 1C, G3 2 6.94 3 27.20 4 74.35	TEST 6 RUN 8 N 1D, G3 2 5.63 3 27.40 4 81.30	TEST 6 RUN 21 N 1D, G3 2 5.18 3 27.86 4 78.12	TEST 6 RUN 5 N 1E, G3 2 5.46 3 25.97 4 71.94	TEST 6 RUN 18 N 1E, G3 2 5.91 3 26.74 4 70.42	TEST 6 RUN 15 N 1E, G3 2 5.77 3 26.95 4 79.37	TEST 2 RUN 72/0 N 2A, G3 2 5.20 3 11.98 4 23.75
TEST 2 RUN 161/0 N 2A, G3 2 5.26 3 12.23 4 23.58	TEST 2 RUN 261/0 N 2A, G3 2 5.17 3 12.69 4 24.35	TEST 6 RUN 11 N 2E, G3 2 3 12.58 4 25.64	TEST 2 RUN 27/0 N 1B, G4 2 5.25 3 24.55 4 64.60	TEST 2 RUN 28/0 N 1B, G4 2 5.17 3 22.41 4 62.11	TEST 2 RUN 29/0 N 1B, G4 2 5.36 3 24.60 4 60.31	TEST 2 RUN 1/1 N 1B, G4 2 4.89 3 22.82 4 57.74	TEST 2 RUN 2/0 N 1B, G4 2 5.10 3 21.23 4 58.00
TEST 2 RUN 3/0 N 1B, G4 2 4.92 3 20.21 4 59.10	TEST 2 RUN 4/2 N 1B, G4 2 5.31 3 23.89 4 62.66	TEST 6 RUN 24 N 1D, G4 2 5.71 3 26.53 4 80.65	TEST 6 RUN 37 N 1D, G4 2 4.49 3 20.75 4 62.89	TEST 6 RUN 43 N 1D, G4 2 5.69 3 23.81 4	TEST 6 RUN 56 N 1D, G4 2 5.73 3 26.88 4 74.07	TEST 6 RUN 27 N 1E, G4 2 6.07 3 28.01 4 72.46	TEST 6 RUN 34 N 1E, G4 2 5.51 3 24.51 4 66.67



TABLE B-5. (Concluded)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 6 RUN 62 N 1E, G4 2 5.87 3 25.13 4 65.36	TEST 6 RUN 50 N 1E, G4 2 5.85 3 25.97 4	TEST 2 RUN 70/0 N 2A, G4 2 5.06 3 11.44 4 19.12	TEST 2 RUN 71/0 N 2A, G4 2 3 11.39 4 23.67	TEST 2 RUN 62/2 N 2A, G4 2 5.30 3 11.41 4	TEST 2 RUN 163/0 N 2A, G4 2 5.24 3 11.55 4 21.22	TEST 6 RUN 31 N 2B, G4 2 3 13.28 4	TEST 6 RUN 66 N 2B, G4 2 3 12.97 4 24.27
TEST 6 RUN 40 N 2B, G4 2 3 13.87 4	TEST 6 RUN 47 N 2B, G4 2 3 11.55 4	TEST 6 RUN 53 N 2B, G4 2 3 12.80 4 25.45					



TABLE B-6. NOZZLE WALL PRESSURES FOR ORBITER GEOMETRY

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 3 RUN 215/0 N31, G1 47 39.85 48 36.62	TEST 3 RUN 210/0 N31, G1 47 41.00 48 36.47	TEST 3 RUN 209/0 N31, G1 47 42.41 48 36.82	TEST 3 RUN 204/0 N31, G1 47 42.81 48 37.12	TEST 3 RUN 216/0 N31, G1 47 24.61 48 36.52	TEST 3 RUN 223/0 N31, G1 47 42.43 48 36.67	TEST 3 RUN 214/0 N31, G1 47 42.00 48 36.60	TEST 3 RUN 211/0 N31, G1 47 41.80 48 36.46
TEST 3 RUN 208/0 N31, G1 47 42.47 48 36.80	TEST 3 RUN 205/0 N31, G1 47 43.07 48 37.09	TEST 3 RUN 217/0 N31, G1 47 32.22 48 36.12	TEST 3 RUN 224/0 N31, G1 47 43.84 48 36.81	TEST 3 RUN 213/1 N31, G1 47 42.10 48 36.68	TEST 3 RUN 212/0 N31, G1 47 41.76 48 35.47	TEST 3 RUN 222/0 N31, G1 47 42.37 48 36.74	TEST 3 RUN 221/0 N31, G1 47 43.07 48 37.09
TEST 3 RUN 195/0 N31, G1 47 39.96 48 38.01	TEST 3 RUN 194/0 N31, G1 47 34.82 48 35.09	TEST 3 RUN 207/0 N31, G1 47 45.26 48 36.77	TEST 3 RUN 196/0 N31, G1 47 42.02 48 36.00	TEST 3 RUN 199/0 N31, G1 47 42.03 48 36.38	TEST 3 RUN 198/0 N31, G1 47 41.68 48 36.25	TEST 3 RUN 197/0 N31, G1 47 41.99 48 36.30	TEST 3 RUN 201/0 N31, G1 47 42.32 48 36.72
TEST 3 RUN 200/0 N31, G1 47 42.10 48 36.71	TEST 3 RUN 203/0 N31, G1 47 42.76 48 37.05	TEST 3 RUN 202/0 N31, G1 47 42.86 48 36.98	TEST 3 RUN 121/0 N32, G1 47 28.90 48 29.58	TEST 3 RUN 114/0 N32, G1 47 28.54 48 29.52	TEST 3 RUN 115/0 N32, G1 47 29.23 48 30.07	TEST 3 RUN 120/0 N32, G1 47 29.02 48 29.73	TEST 3 RUN 136/0 N32, G1 47 29.96 48 30.89
TEST 3 RUN 130/0 N32, G1 47 30.02 48 30.79	TEST 3 RUN 137/0 N32, G1 47 30.25 48 31.26	TEST 3 RUN 131/0 N32, G1 47 30.26 48 31.26	TEST 3 RUN 111/0 N32, G1 47 28.82 48 29.04	TEST 3 RUN 124/0 N32, G1 47 21.86 48 26.01	TEST 3 RUN 122/0 N32, G1 47 28.88 48 29.57	TEST 3 RUN 112/0 N32, G1 47 28.95 48 29.54	TEST 3 RUN 116/0 N32, G1 47 29.28 48 30.14
TEST 3 RUN 119/0 N32, G1 47 29.05 48 29.80	TEST 3 RUN 135/0 N32, G1 47 29.92 48 30.87	TEST 3 RUN 126/1 N32, G1 47 30.09 48 30.94	TEST 3 RUN 132/0 N32, G1 47 30.20 48 31.18	TEST 3 RUN 138/0 N32, G1 47 30.31 48 31.35	TEST 3 RUN 110/1 N32, G1 47 20.47 48 29.43	TEST 3 RUN 109/2 N32, G1 47 28.72 48 29.79	TEST 3 RUN 123/0 N32, G1 47 28.91 48 29.64

TABLE B-6. (Continued)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 3 RUN 113/0 N32 , G1 47 28.88 48 29.52	TEST 3 RUN 117/0 N32 , G1 47 29.22 48 30.09	TEST 3 RUN 118/0 N32 , G1 47 29.89 48 29.82	TEST 3 RUN 134/0 N32 , G1 47 30.03 48 30.93	TEST 3 RUN 129/0 N32 , G1 47 29.96 48 30.77	TEST 3 RUN 139/1 N32 , G1 47 30.28 48 31.31	TEST 3 RUN 133/0 N32 , G1 47 30.26 48 31.26	TEST 3 RUN 148/0 N32 , G1 47 29.13 48 30.59
TEST 3 RUN 149/0 N32 , G1 47 29.50 48 31.09	TEST 3 RUN 146/0 N32 , G1 47 28.92 48 29.42	TEST 3 RUN 145/1 N32 , G1 47 29.14 48 29.71	TEST 3 RUN 144/1 N32 , G1 47 29.16 48 29.75	TEST 3 RUN 147/0 N32 , G1 47 29.33 48 29.93	TEST 3 RUN 142/0 N32 , G1 47 29.77 48 30.62	TEST 3 RUN 141/0 N32 , G1 47 29.91 48 30.83	TEST 3 RUN 140/0 N32 , G1 47 30.28 48 31.31
TEST 3 RUN 143/0 N32 , G1 47 30.28 48 31.27	TEST 3 RUN 67/0 N33 , G1 47 18.27 48 17.44	TEST 3 RUN 56/0 N33 , G1 47 18.96 48 18.62	TEST 3 RUN 62/0 N33 , G1 47 72.89 48 72.86	TEST 3 RUN 61/0 N33 , G1 47 71.98 48 72.15	TEST 3 RUN 76/0 N33 , G1 47 73.48 48 73.85	TEST 3 RUN 71/0 N33 , G1 47 73.10 48 73.43	TEST 3 RUN 77/0 N33 , G1 47 74.29 48 74.70
TEST 3 RUN 82/1 N33 , G1 47 74.14 48 74.59	TEST 3 RUN 83/0 N33 , G1 47 74.98 48 75.39	TEST 3 RUN 86/0 N33 , G1 47 75.07 48 75.34	TEST 3 RUN 66/0 N33 , G1 47 24.25 48 25.47	TEST 3 RUN 57/0 N33 , G1 47 33.75 48 30.33	TEST 3 RUN 60/0 N33 , G1 47 72.30 48 72.53	TEST 3 RUN 63/1 N33 , G1 47 72.93 48 73.03	TEST 3 RUN 75/0 N33 , G1 47 74.00 48 73.89
TEST 3 RUN 72/0 N33 , G1 47 73.10 48 73.72	TEST 3 RUN 91/0 N33 , G1 47 74.12 48 74.47	TEST 3 RUN 78/0 N33 , G1 47 74.40 48 74.78	TEST 3 RUN 84/0 N33 , G1 47 75.00 48 75.45	TEST 3 RUN 87/0 N33 , G1 47 75.11 48 75.37	TEST 3 RUN 65/0 N33 , G1 47 34.65 48 68.19	TEST 3 RUN 58/0 N33 , G1 47 72.93 48 71.21	TEST 3 RUN 64/0 N33 , G1 47 73.15 48 73.20
TEST 3 RUN 59/0 N33 , G1 47 72.44 48 72.69	TEST 3 RUN 74/1 N33 , G1 47 73.58 48 73.89	TEST 3 RUN 73/0 N33 , G1 47 73.21 48 73.67	TEST 3 RUN 80/0 N33 , G1 47 74.10 48 74.43	TEST 3 RUN 79/0 N33 , G1 47 74.36 48 74.73	TEST 3 RUN 86/0 N33 , G1 47 75.24 48 75.51	TEST 3 RUN 85/0 N33 , G1 47 75.23 48 75.57	

TABLE B-6. (Continued)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 1 RUN 423/0 N34B, G1 47 30.23	TEST 1 RUN 455/0 N34B, G1 47 30.77	TEST 1 RUN 454/0 N34B, G1 47 41.90	TEST 1 RUN 422/0 N34B, G1 47 43.64	TEST 1 RUN 457/0 N34B, G1 47 44.58	TEST 1 RUN 425/0 N34B, G1 47 46.51	TEST 1 RUN 453/0 N34B, G1 47 52.13	TEST 1 RUN 421/0 N34B, G1 47 52.16
TEST 1 RUN 459/0 N34B, G1 47 56.71	TEST 1 RUN 452/0 N34B, G1 47 57.14	TEST 1 RUN 420/0 N34B, G1 47 57.03	TEST 1 RUN 448/0 N34B, G1 47 26.67	TEST 1 RUN 416/0 N34B, G1 47 30.61	TEST 1 RUN 462/0 N34B, G1 47 43.16	TEST 1 RUN 417/0 N34B, G1 47 44.05	TEST 1 RUN 449/0 N34B, G1 47 43.73
TEST 1 RUN 430/0 N34B, G1 47 45.87	TEST 1 RUN 418/0 N34B, G1 47 52.27	TEST 1 RUN 450/0 N34B, G1 47 52.26	TEST 1 RUN 451/0 N34B, G1 47 54.35	TEST 1 RUN 419/0 N34B, G1 47 56.72	TEST 1 RUN 460/0 N34B, G1 47 56.71	TEST 1 RUN 415/0 N34B, G1 47 29.84	TEST 1 RUN 447/0 N34B, G1 47 31.75
TEST 1 RUN 414/0 N34B, G1 47 43.89	TEST 1 RUN 467/0 N34B, G1 47 43.54	TEST 1 RUN 446/0 N34B, G1 47 44.05	TEST 1 RUN 433/0 N34B, G1 47 47.39	TEST 1 RUN 413/0 N34B, G1 47 51.02	TEST 1 RUN 445/0 N34B, G1 47 52.17	TEST 1 RUN 412/0 N34B, G1 47 56.50	TEST 1 RUN 444/0 N34B, G1 47 56.82
TEST 1 RUN 465/0 N34B, G1 47 56.82	TEST 1 RUN 471/0 N34B, G1 47 26.16	TEST 1 RUN 440/0 N34B, G1 47 29.31	TEST 1 RUN 408/0 N34B, G1 47 30.57	TEST 1 RUN 470/0 N34B, G1 47 41.41	TEST 1 RUN 409/0 N34B, G1 47 43.38	TEST 1 RUN 441/0 N34B, G1 47 44.31	TEST 1 RUN 438/1 N34B, G1 47 46.12
TEST 1 RUN 442/0 N34B, G1 47 50.76	TEST 1 RUN 469/0 N34B, G1 47 51.50	TEST 1 RUN 410/0 N34B, G1 47 51.61	TEST 1 RUN 411/0 N34B, G1 47 57.14	TEST 1 RUN 443/0 N34B, G1 47 56.87	TEST 1 RUN 468/0 N34B, G1 47 56.93	TEST 1 RUN 615/0 N33B, G2 47 42.16	TEST 1 RUN 616/0 N33B, G2 47 42.16
TEST 1 RUN 607/0 N33B, G2 47 43.01	TEST 1 RUN 617/0 N33B, G2 47 42.05	TEST 1 RUN 634/0 N33B, G2 47 40.79	TEST 1 RUN 618/0 N33B, G2 47 42.19	TEST 1 RUN 622/0 N33B, G2 47 42.11	TEST 1 RUN 621/0 N33B, G2 47 42.19	TEST 1 RUN 620/0 N33B, G2 47 42.16	TEST 1 RUN 633/0 N33B, G2 47 40.76

TABLE B-6. (Concluded)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 1 RUN 608/0 N33B, G2 47 42.55	TEST 1 RUN 619/0 N33B, G2 47 42.40	TEST 1 RUN 623/0 N33B, G2 47 41.81	TEST 1 RUN 632/0 N33B, G2 47 40.87	TEST 1 RUN 624/0 N33B, G2 47 42.31	TEST 1 RUN 612/0 N33B, G2 47 40.90	TEST 1 RUN 609/0 N33B, G2 47 44.61	TEST 1 RUN 625/0 N33B, G2 47 42.25
TEST 1 RUN 626/0 N33B, G2 47 42.40	TEST 1 RUN 630/0 N33B, G2 47 41.70	TEST 1 RUN 629/0 N33B, G2 47 42.25	TEST 1 RUN 611/0 N33B, G2 47 41.55	TEST 1 RUN 628/0 N33B, G2 47 42.05	TEST 1 RUN 610/0 N33B, G2 47 42.86	TEST 1 RUN 631/0 N33B, G2 47 41.07	TEST 1 RUN 627/0 N33B, G2 47 42.28



TABLE B-7. NOZZLE WALL PRESSURES FOR ET/SRB CLASS

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7
RUN 72/2	RUN 61/2	RUN 50/2	RUN 65/2	RUN 49/2	RUN 73/4	RUN 40/2	RUN 86/2
LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1
22 27.55	22 27.39	22 27.70	22 26.89	22 28.19	22 28.29	22 .00	22 28.50
23 80.44	23 89.17	23 81.30	23 83.29	23 82.57	23 82.14	23 .00	23 82.36
24 129.59	24 132.40	24 129.53	24 132.03	24 132.43	24 130.07	24 .00	24 128.75
RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1
32 30.42	32 29.60	32 30.41	32 29.57	32 31.05	32 31.02	32 .00	32 31.07
33 76.29	33 76.95	33 77.41	33 77.00	33 78.91	33 77.68	33 .00	33 77.48
34 125.99	34 124.50	34 126.23	34 123.83	34 131.33	34 129.00	34 .00	34 128.52
TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7
RUN 60/2	RUN 64/2	RUN 51/2	RUN 71/2	RUN 48/2	RUN 74/2	RUN 41/2	RUN 85/2
LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1
22 27.32	22 26.74	22 27.74	22 27.40	22 28.11	22 27.91	22 .00	22 28.30
23 87.34	23 83.54	23 84.78	23 80.16	23 82.35	23 80.54	23 .00	23 81.66
24 135.56	24 134.05	24 136.72	24 129.25	24 133.39	24 127.85	24 .00	24 127.27
RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1
32 28.86	32 28.94	32 30.25	32 29.94	32 30.57	32 30.31	32 .00	32 30.72
33 77.18	33 77.60	33 80.10	33 75.39	33 78.39	33 76.18	33 .00	33 76.84
34 126.29	34 125.54	34 133.97	34 126.31	34 133.19	34 127.06	34 .00	34 127.14
TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7
RUN 62/2	RUN 63/2	RUN 52/2	RUN 70/8	RUN 47/2	RUN 75/2	RUN 59/4	RUN 84/2
LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1	LN 24A,G1
22 26.08	22 25.90	22 27.06	22 26.78	22 27.72	22 27.61	22 28.12	22 28.05
23 89.65	23 85.24	23 83.65	23 80.11	23 84.45	23 80.95	23 81.39	23 82.19
24 139.39	24 138.06	24 137.49	24 130.32	24 139.35	24 128.64	24 129.42	24 127.77
RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1	RN 24B,G1
32 27.39	32 27.59	32 29.08	32 28.95	32 30.23	32 29.85	32 30.49	32 30.35
33 77.50	33 77.11	33 78.41	33 75.06	33 80.02	33 76.04	33 77.45	33 76.77
34 130.89	34 130.48	34 136.24	34 128.62	34 140.94	34 128.40	34 130.08	34 127.84



TABLE B-7. (Continued)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 7 RUN 56/2 LN 24A,G1 22 27.23 23 83.81 24 143.18 RN 24B,G1 32 26.30 33 78.09 34 132.30	TEST 7 RUN 66/2 LN 24A,G1 22 26.44 23 81.65 24 138.62 RN 24B,G1 32 27.99 33 76.17 34 130.64	TEST 7 RUN 53/2 LN 24A,G1 22 27.14 23 83.72 24 142.37 RN 24B,G1 32 29.47 33 79.13 34 140.62	TEST 7 RUN 69/2 LN 24A,G1 22 26.83 23 80.82 24 133.02 RN 24B,G1 32 29.03 33 75.63 34 131.58	TEST 7 RUN 46/2 LN 24A,G1 22 .00 23 .00 24 .00 RN 24B,G1 32 .00 33 .00 34 .00	TEST 7 RUN 76/2 LN 24A,G1 22 27.68 23 80.67 24 128.90 RN 24B,G1 32 29.82 33 75.97 34 128.42	TEST 7 RUN 43/3 LN 24A,G1 22 .00 23 .00 24 .00 RN 24B,G1 32 .00 33 .00 34 .00	TEST 7 RUN 79/3 LN 24A,G1 22 28.43 23 81.65 24 129.69 RN 24B,G1 32 30.62 33 77.33 34 130.00
TEST 7 RUN 55/3 LN 24A,G1 22 27.33 23 89.94 24 150.58 RN 24B,G1 32 29.63 33 84.37 34 137.30	TEST 7 RUN 67/2 LN 24A,G1 22 26.86 23 81.75 24 141.58 RN 24B,G1 32 28.54 33 77.49 34 133.27	TEST 7 RUN 68/2 LN 24A,G1 22 27.11 23 79.37 24 132.17 RN 24B,G1 32 29.29 33 75.44 34 129.93	TEST 7 RUN 54/2 LN 24A,G1 22 27.17 23 81.92 24 139.40 RN 24B,G1 32 29.37 33 77.83 34 137.40	TEST 7 RUN 45/3 LN 24A,G1 22 .00 23 .00 24 .00 RN 24B,G1 32 .00 33 .00 34 .00	TEST 7 RUN 77/3 LN 24A,G1 22 28.10 23 81.52 24 131.86 RN 24B,G1 32 30.24 33 77.21 34 132.33	TEST 7 RUN 44/2 LN 24A,G1 22 .00 23 .00 24 .00 RN 24B,G1 32 .00 33 .00 34 .00	TEST 7 RUN 78/2 LN 24A,G1 22 28.62 23 82.27 24 130.13 RN 24B,G1 32 30.89 33 77.80 34 130.44
TEST 7 RUN 164/4 LN 24A,G1 22 29.21 23 70.40 24 140.44 RN 24B,G1 32 30.77 33 73.08 34 126.08	TEST 7 RUN 163/2 LN 24A,G1 22 28.41 23 75.76 24 133.11 RN 24B,G1 32 30.66 33 75.43 34 127.68	TEST 7 RUN 162/2 LN 24A,G1 22 28.55 23 77.12 24 131.75 RN 24B,G1 32 30.97 33 76.45 34 128.51	TEST 7 RUN 161/3 LN 24A,G1 22 27.98 23 74.91 24 124.47 RN 24B,G1 32 30.31 33 73.24 34 122.70	TEST 7 RUN 114/2 LN 23A,G1 22 24.50 23 31.74 24 40.16 RN 23B,G1 32 22.87 33 30.03 34 40.74	TEST 7 RUN 121/2 LN 23A,G1 22 24.50 23 31.68 24 39.40 RN 23B,G1 32 23.03 33 30.00 34 39.73	TEST 7 RUN 109/3 LN 23A,G1 22 24.52 23 32.34 24 40.62 RN 23B,G1 32 23.39 33 30.34 34 40.01	TEST 7 RUN 113/2 LN 23A,G1 22 24.15 23 31.95 24 40.51 RN 23B,G1 32 22.32 33 30.07 34 41.27

TABLE B-7. (Continued)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7
RUN 111/2	RUN 110/2	RUN 115/2	RUN 120/2	RUN 122/3	RUN 116/2	RUN 119/2	RUN 117/2
LN 23A,G1	LN 23A,G1	LN 23A,G1	LN 23A,G1	LN 23A,G1	LN 23A,G1	LN 23A,G1	LN 23A,G1
22 24.15	22 24.43	22 23.81	22 24.12	22 24.28	22 23.86	22 24.25	22 24.58
23 31.81	23 32.03	23 31.91	23 31.66	23 31.95	23 32.01	23 31.67	23 31.74
24 39.17	24 39.47	24 40.30	24 39.34	24 39.31	24 40.33	24 39.34	24 40.12
RN 23B,G1	RN 23B,G1	RN 23B,G1	RN 23B,G1	RN 23B,G1	RN 23B,G1	RN 23B,G1	RN 23B,G1
32 22.65	32 23.06	32 21.89	32 22.56	32 22.97	32 21.88	32 22.65	32 22.34
33 29.93	33 30.22	33 29.81	33 29.89	33 30.21	33 29.93	33 29.88	33 30.05
34 39.82	34 137.25	34 40.77	34 39.77	34 39.73	34 41.12	34 39.79	34 40.80
TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7
RUN 118/3	RUN 123/2	RUN 172/2	RUN 171/2	RUN 170/5	RUN 137/2	RUN 128/2	RUN 138/3
LN 23A,G1	LN 23A,G1	LN 23A,G1	LN 23A,G1	LN 23A,G1	LN 22A,G2	LN 22A,G2	LN 22A,G2
22 24.45	22 24.47	22 24.78	22 24.51	22 24.53	22 3.68	22 3.63	22 3.69
23 31.69	23 31.84	23 30.60	23 31.14	23 31.44	23 15.97	23 16.14	23 16.07
24 39.29	24 39.33	24 40.76	24 39.79	24 39.38	24 42.63	24 43.53	24 42.23
RN 23B,G1	RN 23B,G1	RN 23B,G1	RN 23B,G1	RN 23B,G1	RN 22B,G2	RN 22B,G2	RN 22B,G2
32 22.67	32 23.07	32 23.18	32 23.12	32 23.33	32 3.83	32 3.81	32 3.85
33 29.91	33 30.09	33 29.88	33 29.87	33 29.97	33 17.03	33 17.05	33 17.04
34 39.83	34 39.47	34 40.01	34 40.02	34 39.26	34 44.64	34 45.60	34 44.46
TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7	TEST 7
RUN 129/2	RUN 136/2	RUN 139/2	RUN 130/2	RUN 135/2	RUN 140/2	RUN 147/2	RUN 131/2
LN 22A,G2	LN 22A,G2	LN 22A,G2	LN 22A,G2	LN 22A,G2	LN 22A,G2	LN 22A,G2	LN 22A,G2
22 3.64	22 3.68	22 3.69	22 3.63	22 3.67	22 3.68	22 4.56	22 3.62
23 16.34	23 15.95	23 16.07	23 16.24	23 15.96	23 16.04	23 16.09	23 16.09
24 44.81	24 42.42	24 42.14	24 44.19	24 42.42	24 41.96	24 44.65	24 43.98
RN 22B,G2	RN 22B,G2	RN 22B,G2	RN 22B,G2	RN 22B,G2	RN 22B,G2	RN 22B,G2	RN 22B,G2
32 3.85	32 3.82	32 3.85	32 3.79	32 3.80	32 3.84	32 4.55	32 3.78
33 17.32	33 17.03	33 17.00	33 17.13	33 16.97	33 16.94	33 16.98	33 17.05
34 47.11	34 44.53	34 44.36	34 46.16	34 44.58	34 44.28	34 45.33	34 45.93

TABLE B-7. (Continued)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 7 RUN 134/3 LN 22A,G2 22 3.66 23 15.95 24 42.56 RN 22B,G2 32 3.81 33 16.99 34 44.91	TEST 7 RUN 142/2 LN 22A,G2 22 3.68 23 15.98 24 41.78 RN 22B,G2 32 3.83 33 16.92 34 44.04	TEST 7 RUN 146/2 LN 22A,G2 22 4.55 23 16.05 24 44.54 RN 22B,G2 32 4.54 33 16.95 34 45.22	TEST 7 RUN 132/2 LN 22A,G2 22 3.63 23 16.01 24 44.13 RN 22B,G2 32 3.76 33 16.96 34 46.01	TEST 7 RUN 133/2 LN 22A,G2 22 3.66 23 15.82 24 42.10 RN 22B,G2 32 3.80 33 16.83 34 44.27	TEST 7 RUN 141/2 LN 22A,G2 22 3.69 23 15.89 24 41.62 RN 22B,G2 32 3.84 33 16.88 34 43.86	TEST 7 RUN 145/2 LN 22A,G2 22 4.54 23 16.10 24 44.41 RN 22B,G2 32 4.52 33 16.94 34 45.07	TEST 7 RUN 156/4 LN 22A,G2 22 3.66 23 15.50 24 43.41 RN 22B,G2 32 3.80 33 16.92 34 45.29
TEST 7 RUN 155/2 LN 22A,G2 22 3.67 23 15.71 24 41.82 RN 22B,G2 32 3.81 33 16.84 34 43.89	TEST 7 RUN 154/2 LN 22A,G2 22 3.69 23 15.79 24 41.36 RN 22B,G2 32 3.85 33 16.82 34 43.52	TEST 8 RUN 14 LN 21A,G5 25 8.37 26 10.57 27 13.04 RN 21B,G5 22 8.22 23 10.52 24 13.48	TEST 8 RUN 31 LN 21A,G5 25 8.58 26 10.84 27 13.32 RN 21B,G5 22 7.76 23 9.27 24 14.02	TEST 8 RUN 20 LN 21A,G5 25 8.30 26 10.73 27 13.44 RN 21B,G5 22 7.82 23 10.51 24 13.82	TEST 8 RUN 33 LN 21A,G5 25 8.79 26 11.11 27 13.65 RN 21B,G5 22 8.54 23 13.15 24 15.08	TEST 8 RUN 21 LN 21A,G5 25 8.93 26 11.23 27 13.78 RN 21B,G5 22 7.26 23 15.29 24 13.71	TEST 8 RUN 7 LN 21A,G5 25 8.05 26 10.15 27 13.04 RN 21B,G5 22 7.67 23 8.28 24 12.87
TEST 8 RUN 24 LN 21A,G5 25 8.60 26 11.04 27 13.60 RN 21B,G5 22 8.31 23 11.36 24 14.23	TEST 8 RUN 6 LN 21A,G5 25 8.18 26 10.55 27 12.90 RN 21B,G5 22 7.86 23 14.73 24 13.26	TEST 8 RUN 25 LN 21A,G5 25 8.03 26 10.44 27 13.08 RN 21B,G5 22 7.82 23 10.86 24 14.06	TEST 8 RUN 8 LN 21A,G5 25 8.58 26 10.60 27 13.20 RN 21B,G5 22 8.29 23 14.40 24 13.97	TEST 8 RUN 15 LN 21A,G5 25 9.15 26 11.78 27 14.30 RN 21B,G5 22 7.57 23 10.89 24 13.87	TEST 8 RUN 27 LN 21A,G5 25 7.87 26 9.83 27 12.57 RN 21B,G5 22 7.66 23 10.54 24 13.94	TEST 8 RUN 17 LN 21A,G5 25 8.49 26 10.98 27 13.72 RN 21B,G5 22 8.14 23 10.60 24 14.15	TEST 8 RUN 28 LN 21A,G5 25 8.23 26 10.49 27 13.19 RN 21B,G5 22 7.99 23 10.59 24 14.35

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TABLE B-7. (Concluded)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 8 RUN 19	TEST 8 RUN 5	TEST 8 RUN 10	TEST 8 RUN 22	TEST 8 RUN 9	TEST 8 RUN 23	TEST 8 RUN 11	TEST 8 RUN 12
LN 21A,G5	LN 21A,G5	LN 21A,G5	LN 21A,G5	LN 21A,G5	LN 21A,G5	LN 21A,G5	LN 21A,G5
25 8.46	25 8.20	25 8.16	25 8.23	25 8.43	25 8.76	25 8.45	25 8.37
26 10.68	26 10.53	26 10.52	26 10.56	26 10.68	26 11.04	26 10.78	26 10.67
27 13.24	27 12.96	27 13.12	27 13.04	27 13.25	27 13.45	27 13.40	27 13.04
RN 21B,G5	RN 21B,G5	RN 21B,G5	RN 21B,G5	RN 21B,G5	RN 21B,G5	RN 21B,G5	RN 21B,G5
22 7.04	22 7.16	22 7.91	22 7.69	22 7.84	22 7.90	22 7.31	22 9.25
23 14.84	23 10.41	23 8.42	23 8.23	23 10.78	23 11.05	23 15.44	23 9.13
24 13.34	24 12.89	24 13.84	24 13.84	24 13.56	24 13.90	24 13.87	24 15.74
TEST 8 RUN 30	TEST 8 RUN 26	TEST 8 RUN 32	TEST 8 RUN 13	TEST 8 RUN 29	TEST 8 RUN 16		
LN 21A,G5	LN 21A,G5	LN 21A,G5	LN 21A,G5	LN 21A,G5	LN 21A,G5		
25 8.67	25 9.55	25 8.64	25 8.04	25 8.56	25 8.37		
26 11.26	26 11.91	26 10.90	26 10.55	26 10.90	26 11.06		
27 13.93	27 14.87	27 13.19	27 13.59	27 13.42	27 13.82		
RN 21B,G5	RN 21B,G5	RN 21B,G5	RN 21B,G5	RN 21B,G5	RN 21B,G5		
22 8.53	22 8.28	22 7.82	22 8.03	22 7.96	22 7.71		
23 11.14	23 11.75	23 9.85	23 11.13	23 9.34	23 15.48		
24 16.54	24 14.54	24 14.34	24 14.37	24 14.48	24 14.00		

TABLE B-8. NOZZLE WALL PRESSURES FOR SRB CLASS

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 10 RUN 104/0 N11 , G2 1 44.40 2 33.70 3 18.90	TEST 10 RUN 105/0 N11 , G2 1 44.00 2 33.50 3 18.60	TEST 10 RUN 106/0 N11 , G2 1 43.90 2 33.50 3 18.80	TEST 10 RUN 107/0 N11 , G2 1 42.90 2 32.60 3 18.30	TEST 10 RUN 103/0 N11 , G2 1 42.60 2 32.20 3 18.10	TEST 10 RUN 102/0 N11 , G2 1 44.10 2 33.50 3 18.70	TEST 10 RUN 101/0 N11 , G2 1 44.00 2 33.50 3 18.70	TEST 10 RUN 100/0 N11 , G2 1 43.70 2 33.30 3 18.50
TEST 10 RUN 96/0 N11 , G2 1 43.80 2 33.10 3 20.30	TEST 10 RUN 97/0 N11 , G2 1 44.90 2 34.00 3 20.50	TEST 10 RUN 98/0 N11 , G2 1 43.20 2 32.90 3 19.00	TEST 10 RUN 99/1 N11 , G2 1 43.80 2 33.40 3 18.70	TEST 10 RUN 92/0 N11 , G2 1 46.00 2 34.50 3 21.30	TEST 10 RUN 94/1 N11 , G2 1 43.90 2 33.50 3 18.60	TEST 10 RUN 95/0 N11 , G2 1 44.00 2 33.50 3 21.10	TEST 10 RUN 88/2 N11 , G2 1 45.00 2 34.10 3 22.10
TEST 10 RUN 89/1 N11 , G2 1 43.30 2 33.00 3 19.90	TEST 10 RUN 108/1 N11 , G2 1 44.60 2 33.60 3 19.80	TEST 10 RUN 109/0 N11 , G2 1 45.60 2 34.30 3 20.30	TEST 10 RUN 110/0 N11 , G2 1 44.40 2 33.60 3 19.10	TEST 10 RUN 111/0 N11 , G2 1 43.90 2 33.40 3 19.20	TEST 10 RUN 50/0 N12 , G1 1 46.80 2 35.30 3 27.50	TEST 10 RUN 49/0 N12 , G1 1 46.50 2 35.20 3 27.50	TEST 10 RUN 48/0 N12 , G1 1 46.20 2 35.00 3 27.50
TEST 10 RUN 47/1 N12 , G1 1 46.00 2 35.00 3 27.50	TEST 10 RUN 51/0 N12 , G1 1 46.90 2 35.40 3 27.60	TEST 10 RUN 52/0 N12 , G1 1 46.50 2 35.10 3 27.40	TEST 10 RUN 53/0 N12 , G1 1 46.00 2 35.00 3 27.40	TEST 10 RUN 54/0 N12 , G1 1 46.00 2 35.00 3 27.60	TEST 10 RUN 58/0 N12 , G1 1 47.30 2 35.70 3 27.60	TEST 10 RUN 57/0 N12 , G1 1 46.60 2 35.30 3 27.50	TEST 10 RUN 56/0 N12 , G1 1 46.00 2 35.00 3 27.50
TEST 10 RUN 55/0 N12 , G1 1 46.10 2 35.10 3 27.80	TEST 10 RUN 62/0 N12 , G1 1 47.40 2 35.70 3 27.70	TEST 10 RUN 61/1 N12 , G1 1 46.50 2 35.20 3 27.50	TEST 10 RUN 60/0 N12 , G1 1 46.00 2 35.00 3 27.50	TEST 10 RUN 59/0 N12 , G1 1 46.10 2 35.20 3 27.90	TEST 10 RUN 63/0 N12 , G1 1 47.60 2 35.80 3 27.70	TEST 10 RUN 64/0 N12 , G1 1 44.70 2 34.00 3 26.60	TEST 10 RUN 65/0 N12 , G1 1 46.00 2 34.90 3 27.40

TABLE B-8. (Concluded)

TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P	TAP PC/P
TEST 10 RUN 66/0 N12 , G1 1 46.20 2 35.30 3 28.00	TEST 10 RUN 46/0 N12 , G1 1 47.70 2 36.00 3 27.80	TEST 10 RUN 45/0 N12 , G1 1 46.40 2 35.10 3 27.50	TEST 10 RUN 44/0 N12 , G1 1 46.00 2 35.10 3 27.70	TEST 10 RUN 43/0 N12 , G1 1 46.30 2 35.30 3 28.00	TEST 10 RUN 27/0 N12 , G1 1 46.70 2 35.30 3 27.40	TEST 10 RUN 28/0 N12 , G1 1 46.40 2 35.10 3 27.40	TEST 10 RUN 29/0 N12 , G1 1 45.50 2 34.60 3 27.00
TEST 10 RUN 30/0 N12 , G1 1 45.50 2 34.60 3 27.20	TEST 10 RUN 26/0 N12 , G1 1 46.20 2 34.90 3 27.10	TEST 10 RUN 25/0 N12 , G1 1 46.50 2 35.20 3 27.40	TEST 10 RUN 24/1 N12 , G1 1 46.10 2 35.00 3 27.40	TEST 10 RUN 23/0 N12 , G1 1 45.80 2 35.00 3 27.60	TEST 10 RUN 19/0 N12 , G1 1 47.90 2 35.60 3 27.60	TEST 10 RUN 20/0 N12 , G1 1 46.80 2 35.20 3 27.40	TEST 10 RUN 21/0 N12 , G1 1 46.00 2 35.00 3 27.40
TEST 10 RUN 22/0 N12 , G1 1 46.00 2 35.20 3 27.80	TEST 10 RUN 18/0 N12 , G1 1 48.10 2 35.80 3 27.60	TEST 10 RUN 17/0 N12 , G1 1 46.70 2 35.20 3 27.50	TEST 10 RUN 16/0 N12 , G1 1 46.10 2 35.10 3 27.60	TEST 10 RUN 15/0 N12 , G1 1 46.20 2 35.40 3 28.00	TEST 10 RUN 11/1 N12 , G1 1 44.80 2 33.90 3 26.30	TEST 10 RUN 12/0 N12 , G1 1 46.70 2 35.30 3 27.40	TEST 10 RUN 13/0 N12 , G1 1 46.10 2 35.00 3 27.40
TEST 10 RUN 14/0 N12 , G1 1 46.20 2 35.40 3 28.00	TEST 10 RUN 34/0 N12 , G1 1 47.50 2 36.10 3 27.80	TEST 10 RUN 33/1 N12 , G1 1 46.20 2 35.20 3 27.40	TEST 10 RUN 31/1 N12 , G1 1 45.90 2 35.10 3 27.70	TEST 10 RUN 32/1 N12 , G1 1 45.90 2 35.20 3 27.80			

## APPENDIX C

### NOZZLE CALIBRATION DATA

The nozzle calibration data (wind-off) available for each of the nozzles used during the wind-on runs of the seven selected tests are presented in this appendix. Air was the gas used for most of the calibrations;  $\text{CF}_4$  was used with three nozzles. The test setup is described in Section IV of text. Instrumentation consisted of schlieren photographs of the plumes, model chamber conditions, plenum (ambient) conditions, and nozzle wall pressures. Locations of those nozzle wall pressure taps used only during calibrations are given in Table C-1, and those nozzle taps used during both calibration and wind-on runs are given in Table 7 of text.

Data are given in Tables C-2 through C-4, grouped according to body geometry types. (There were no valid nozzle calibration data for the nozzles used with the ET/SRB body class.) Within each table, data are grouped first by test number, then by gas and nozzle number. This grouping is the same as that used in Appendices A and B. However, there are several additions (air calibrations of nozzles which were used wind-on with nonair gases) and omissions (no calibrations with gases  $G_3$ ,  $G_4$ , or  $G_5$ ; no calibration of nozzles  $N_{21}$ ,  $N_{22}$ ,  $N_{23}$ ,  $N_{24}$ , or  $N_{33}$ ). For each of the test/gas/nozzle groups, a subtitle is provided which includes nozzle design values of  $A/A_*$  and  $\theta_n$ ; exact values of nozzle geometry are given in Table 3 of text. Beneath each subtitle the data are presented in run number sequence.

TABLE C-1. NOZZLE PRESSURE INSTRUMENTATION LOCATIONS  
USED ONLY FOR CALIBRATION RUNS

Nozzle	Upstream Tap				Middle Tap				Downstream Tap							
	Tap No.	$\phi$ (deg)	X/L	A/A*	Tap No.	$\phi$ (deg)	X/L	A/A*	Tap No.	$\phi$ (deg)	X/L	A/A*	Tap No.	$\phi$ (deg)	X/L	A/A*
Classic Geometry																
1A	44	335	0.265	1.58	48	30	0.594	3.96	46	150	0.945	7.39	45	330	0.941	7.35
3	44	330	0.671	2.11	48	30	0.783	2.56	46	150	0.899	3.07	45	330	0.897	3.07
4	44	330	0.721	3.53	48	30	0.837	4.66	46	150	0.944	5.84	45	330	0.959	6.02
5	44	330	0.467	1.69	48	30	0.633	2.19	46	150	0.813	2.80	45	330	0.810	2.79
Orbiter Class																
31A					44	270	0.711	4.29	45	90	0.932	5.08				
B					46	30	0.707	3.82								
C					49	330	0.715	4.78								
32A					44	270	0.712	2.90	45	90	0.937	3.79				
B					46	30	0.686	2.78								
C					49	330	0.687	2.75								
33A									45	90	0.883	6.99	44	270	0.881	6.97
B									46	30	0.882	6.96				
C													49	330	0.880	6.93
34A									45	90	0.801	2.98	44	270	0.808	3.02
B									46	30	0.807	3.08				
C									48	150	0.816	3.07	49	330	0.783	2.90



TABLE C-2. NOZZLE CALIBRATION DATA FOR CLASSIC GEOMETRY

Run/ Rerun	P <sub>amb</sub> (psia)	P <sub>c</sub> (psia)	T <sub>c</sub> (°R)	P <sub>c</sub> / P <sub>w</sub>				
				Tap No.				
				44	48	45	46	47
Test 1, G <sub>1</sub> , N <sub>3</sub> (Air, A/A <sub>*</sub> = 3.5, 25 deg)								
301/0	2.610	181.3	941	17.02	22.14	26.28	26.55	26.51
302/0	2.610	408.1	984	16.71	21.66	26.34	26.13	26.32
303/0	2.610	639.2	996	17.12	22.12	27.02	26.77	26.86
304/0	2.610	923.9	987	17.54	24.11	26.89	27.07	26.98
306/0	2.610	1267.6	1023	17.36	31.75	27.24	27.36	27.14
307/0	2.610	1467.1	1043	17.41	32.53	27.29	27.47	27.30
Test 1, G <sub>1</sub> , N <sub>4</sub> (Air, A/A <sub>*</sub> = 6.5, 35 deg)								
101/0	1.089	115.9	542	63.69	81.04	99.11	89.85	90.58
102/0	0.762	274.4	557	57.47	77.88	95.79	89.53	89.21
103/0	0.587	472.4	563	55.71	77.52	97.85	89.85	89.53
104/0	0.500	936.6	577		80.19	102.46	92.68	91.83
105/0	0.467	1295.0	575		81.83	104.28	93.63	91.91
106/0	0.369	1654.4	567	57.50	84.82	103.73	97.38	94.43
107/0	0.330	1820.3	918	56.56	84.25	102.15	98.14	94.79
108/0	0.533	210.3	897	56.43	77.16	92.42	87.80	86.66
109/0	0.570	412.9	928	56.92	81.17	96.99	94.79	93.28
110/0	0.454	666.1	932	55.31	81.17	97.75	94.97	92.59
111/0	0.572	818.7	969	55.22	81.43	98.33	95.15	92.42
112/0	0.531	960.3	970	55.01	81.63	98.72	95.06	92.59
113/0	1.175	1298.2	993	54.59	80.78	98.62	94.88	91.83
114/0	0.356	1716.6	1008	55.40	82.78	100.30	95.69	93.37
219/0	0.579	194.0	629	57.80	78.68	94.34	89.13	87.95
220/0	0.642	373.4	714	57.05	80.06	96.34	92.76	91.41
221/0	0.564	546.1	739	56.31	79.74	97.56	92.76	89.85
222/0	0.413	810.8	809	56.24	80.65	99.30	93.55	91.24
223/0	0.435	1014.4	852	55.07	81.43	100.50	94.79	92.17
224/0	0.371	1278.2	904	55.07	81.63	100.00	95.42	92.25
Test 3, G <sub>1</sub> , N <sub>4</sub> (Air, A/A <sub>*</sub> = 6.5, 35 deg)								
151/0	0.567	979.6	609	63.44	85.37			111.93
152/0	0.993	981.1	630	63.63	85.62			112.39
153/0	2.141	983.0	637	63.50	85.45			112.03
154/0	4.059	981.9	642	63.58	85.57			112.09
155/0	5.912	984.4	643	63.66	85.69			112.20
156/0	0.567	1484.0	596	65.15	88.02			114.84
157/0	1.016	1491.4	615	65.18	88.15			114.96
158/0	1.901	1472.7	638	65.24	88.22			115.04
159/0	4.001	1478.7	631	65.14	88.06			114.77
160/0	7.656	1479.9	632	65.21	88.13			114.79
161/0	0.544	1453.1	973	63.60	87.57			113.74
162/0	0.939	1462.5	997	62.95	86.84			112.43
163/0	1.836	1463.6	998	63.02	87.00			112.54

TABLE C-2. (Continued)

Run/ Rerun	P <sub>amb</sub> (psia)	P <sub>c</sub> (psia)	T <sub>c</sub> (°R)	P <sub>c</sub> / P <sub>w</sub>				
				Tap No.				
				44	48	45	46	47
164/0	3.986	1467.0	992	63.52	87.66			113.76
165/0	7.586	1471.1	984	63.76	87.98			114.61
166/0	0.540	1460.7	863	63.54	87.49			113.55
167/0	0.923	1459.9	854	63.65	87.72			114.03
168/0	2.168	1465.9	857	63.52	87.53			113.70
169/0	3.963	1476.8	860	63.82	87.94			114.34
170/0	7.525	1483.15	856	63.96	88.08			114.70
171/0	0.540	1496.27	711	64.00	88.08			114.46
172/0	0.896	1492.52	718	63.99	87.97			114.23
173/0	2.118	1496.65	720	63.92	87.98			114.29
174/0	3.909	1488.77	726	64.01	88.10			114.47
175/0	7.439	1484.27	716	64.00	87.99			114.52
176/0	0.556	1989.25	615	66.93	91.05			118.35
177/0	0.811	1970.75	614	66.73	90.78			117.98
178/0	2.021	1971.75	615	67.01	91.20			118.42
179/0	3.816	1981.75	612	67.03	91.22			118.39
180/0	7.664	1972.25	617	66.90	91.00			118.20
181/0	11.303	1973.25	609	66.94	90.90			118.51
Test 3, G <sub>1</sub> , N <sub>5</sub> (Air, A/A* = 3.5, 35 deg)								
1/1	0.579	1039.34	590	20.11	28.23	35.85	35.20	34.98
2/1	0.869	1035.97	619	20.18	28.30	35.91	35.26	35.03
3/1	1.774	1002.22	619	20.09	28.16	35.74	35.07	34.85
4/1	3.885	992.47	617	20.08	28.06	35.67	35.02	34.78
5/1	5.676	1002.22	616	20.05	28.12	35.70	35.07	34.82
6/1	0.525	977.09	672	20.07	28.28	35.72	35.09	34.89
7/1	0.904	996.22	697	20.15	28.31	35.81	35.10	34.94
8/1	1.747	981.59	712	19.97	28.08	35.51	34.89	34.68
9/1	3.854	986.84	710	20.13	28.33	35.79	35.17	34.99
10/1	5.579	982.72	702	20.04	28.14	35.64	35.01	34.79
11/0	0.563	929.47	840	19.78	27.81	35.09	34.49	34.40
12/0	0.927	938.09	863	19.85	27.91	35.22	34.55	34.47
13/0	1.844	931.34	868	19.78	27.81	35.06	34.40	34.23
14/0	3.963	932.09	866	19.91	27.94	35.28	34.57	34.49
15/0	5.785	924.59	865	19.79	27.80	35.06	34.48	34.33
16/1	0.590	1684.47	660	20.91	29.23	37.30	36.94	36.40
17/2	0.799	1694.47	681	20.96	29.35	37.35	36.86	36.35
18/0	1.511	1682.99	689	20.86	29.27	37.20	36.85	36.35
19/0	3.498	1696.49	695	20.90	29.33	37.27	36.83	36.33
20/0	5.425	1704.49	696	20.07	29.34	37.26	36.87	36.32
21/1	0.590	1496.47	871	20.35	28.66	36.38	36.18	35.78
22/0	0.548	1043.97	844	19.79	27.76	35.39	35.00	34.79
23/0	0.590	1337.47	735	20.24	28.47	36.23	35.85	35.44
24/0	0.560	631.97	512	19.41	27.18	34.70	34.18	33.89

TABLE C-2. (Continued)

Run/ Rerun	$P_{amb}$ (psia)	$P_c$ (psia)	$T_c$ (°R)	$P_c/P_w$ $P_c/P_w$				
				Tap No.				
					2	3	4	
Test 2, $G_1$ , $N_{1B}$ (Air, $A/A_* = 8.0$ , 15 deg)								
904/1	1.05	214.79	525		6.26	29.49	88.13	
905/0	1.05	415.45	521		6.27	29.15	86.33	
906/0	1.06	615.45	519		6.30	28.95	85.57	
Test 2, $G_1$ , $N_{1C}$ (Air, $A/A_* = 8.0$ , 15 deg)								
804/0	1.07	215.68	506		7.97	34.50	116.85	
805/0	1.05	415.18	500		7.99	33.70	114.51	
806/0	1.07	615.68	499		8.05	33.37	114.32	
Test 6, $G_1$ , $N_{1D}$ (Air, $A/A_* = 8.0$ , 15 deg)								
1/1	0.990	213.4	499		6.77	34.36	103.59	
2/1	0.968	401.0	517		6.78	34.22	102.56	
3/1	0.975	505.0	513		6.79	34.14	102.43	
Test 6, $G_1$ , $N_{1E}$ (Air, $A/A_* = 8.0$ , 15 deg)								
4/1	0.908	215.4	524		7.10	34.52	91.66	
5/1	0.923	407.0	510		7.13	34.43	91.87	
6/0	0.915	509.5	511		7.13	34.38	91.80	
Test 2, $G_1$ , $N_{2A}$ (Air, $A/A_* = 4.0$ , 15 deg)								
801/0	1.05	214.84	517		6.10	14.61	30.17	
802/0	1.06	415.68	499		6.13	14.62	30.04	
803/0	1.05	615.51	502		6.15	14.65	30.03	
901/0	0.61	216.12	525		6.13	14.75	28.58	
902/0	1.05	415.45	518		6.15	14.83	28.72	
903/0	1.21	616.29	514		6.18	15.01	28.82	
Test 6, $G_1$ , $N_{2B}$ (Air, $A/A_* = 4.0$ , 15 deg)								
7/0	0.975	200.6	504		6.66	16.87	34.53	
8/0	0.983	400.4	505		6.71	16.82	34.73	
9/0	1.170	507.2	506		6.71	16.86	34.91	

TABLE C-2. (Concluded)

Run/ Rerun	P <sub>amb</sub> (psia)	P <sub>c</sub> (psia)	T <sub>c</sub> (°R)	P <sub>c</sub> /P <sub>w</sub>				
				Tap No.				
				44	48	45	46	47
Test 1, G <sub>1</sub> , N <sub>1A</sub> (Air, A/A <sub>*</sub> = 8.0, 15 deg)								
501/0	0.585	486.58	938	8.02	30.97	84.67	90.99	88.65
502/0	0.480	957.64	968	8.10	31.32	85.11	91.41	88.26
503/0	0.379	1334.48	956	8.15	31.62	86.28	92.68	89.53
504/0	0.390	1691.85	978	8.16	31.54	85.91	91.91	88.65
505/0	0.386	1966.58	998	8.26	31.87	86.73	92.68	89.45
Test 1, G <sub>2</sub> , N <sub>1A</sub> (CF <sub>4</sub> , A/A <sub>*</sub> = 8.0, 15 deg)								
506/0	0.424	545.00	931	5.68	18.79	46.00	49.19	47.53
507/0	0.435	980.27	968	5.66	18.49	45.62	48.34	46.95
508/0	0.371	1488.21	895	5.82	19.03	47.26	50.23	48.52
509/0	0.720	1899.26	975	5.87	18.97	46.77	49.88	48.12
511/0	0.409	2017.68	623	5.82	18.65	48.83	51.07	50.15
512/0	0.424	1574.00	563	5.65	18.43	44.88	46.97	46.34
513/0	0.416	1101.89	634	5.76	19.40	50.35	53.08	51.76
514/0	0.473	588.84	601	5.87	20.39	53.16	56.59	54.91

TABLE C-3. NOZZLE CALIBRATION DATA  
FOR ORBITER CLASS

Run/ Rerun	P <sub>amb</sub> (psia)	P <sub>c</sub> (psia)	T <sub>c</sub> ( R)	P <sub>c</sub> / P <sub>w</sub>					
				Tap No.					
				44	46	49	45	47	48
Test 3, G <sub>1</sub> , N <sub>31</sub> (Air, A/A <sub>*</sub> = 5.3, Contoured)									
182/0	0.492	976.20	903		24.58		36.79	42.06	36.71
183/0	0.852	980.32	909		24.54		36.72	41.98	36.65
184/0	1.823	972.07	905		24.51		36.70	41.94	36.63
185/0	2.758	975.07	899		24.60		36.84	42.14	36.82
186/0	0.529	472.45	904		24.16		36.47	41.81	36.34
187/0	1.012	475.70	912		24.11		36.40	41.73	36.24
188/0	2.021	476.57	915		24.14		36.43	41.76	36.28
189/0	2.977	482.07	925		24.07		36.33	41.64	36.19
190/0	0.529	99.47	889		25.32		38.24	42.61	38.93
191/0	1.062	99.26	890		25.32		38.15	42.66	38.90
192/0	2.048	100.16	884		25.30		38.16	42.48	38.85
193/0	3.201	99.59	881		25.18		36.44	35.63	37.67
Test 3, G <sub>1</sub> , N <sub>32</sub> (Air, A/A <sub>*</sub> = 4.0, 10 deg)									
97/0	0.482	978.26	860	21.81	19.82	20.95	29.86	29.99	30.93
98/0	0.819	980.88	867	21.75	19.74	20.87	29.77	29.89	30.88
99/0	1.797	980.51	874	21.68	19.66	20.80	29.66	29.75	30.73
100/0	2.729	982.76	877	21.75	19.74	20.90	29.77	29.92	30.85
101/0	0.521	483.63	886		19.27	20.49	29.38	29.01	29.94
102/0	0.997	487.88	888		19.20	20.43	29.31	28.90	29.81
103/0	2.137	488.51	890		19.21	20.43	29.31	28.90	29.79
104/0	2.988	490.76	895		19.24	20.48	29.38	28.96	29.84
105/0	0.637	104.42	873	21.40	19.67		29.68	29.85	34.02
106/0	1.078	113.06	882	21.31	19.61	20.45	29.51	29.72	33.50
107/0	2.087	114.14	867	21.35	19.60	20.47	29.55	29.70	33.44
108/0	3.240	115.16	861	21.39	19.57	20.41	29.40	29.58	33.40
				44	45	46	47	48	49
Test 1, G <sub>1</sub> , N <sub>31</sub> (Air, A/A <sub>*</sub> = 4.0, 25 deg)									
401/0	0.417	1677.62	854	26.40	24.93	30.24	26.54	27.74	25.31
402/0	0.437	1313.93	849	26.16	24.86	30.03	26.60	27.63	25.21
403/0	0.391	743.90	850	25.39	24.21	29.10	25.48	26.77	24.50
404/0	0.930	475.62	851	24.99	23.87	28.49	24.99	26.33	24.19
405/0	0.451	1493.90	513	26.03	24.74	29.94	26.08	27.65	25.21
406/0	0.409	1704.95	976	26.45	25.23	30.49	26.57	27.99	25.59



TABLE C-3. (Concluded)

Run/ Rerun	P <sub>amb</sub> (psia)	P <sub>c</sub> (psia)	T <sub>c</sub> (°R)	P <sub>c</sub> / P <sub>w</sub>					
				Tap No.					
				44	45	46	47	48	49
Test 1, G <sub>2</sub> , N <sub>33</sub> (CF <sub>4</sub> , A/A <sub>*</sub> = 8.0, 15 deg)									
601/0	2.610	1067.12	581	46.62	44.03	43.71	45.48	44.84	45.45
602/0	2.610	963.96	810	43.18	41.03	41.08	42.05	41.44	41.44
603/0	2.610	563.96	937	41.91	39.37	39.48	40.65	40.29	39.48
604/0	2.610	1076.07	1000	41.48	39.22	39.35	40.58	40.02	39.37
605/0	2.610	1468.17	1019	41.65	39.48	39.59	40.75	40.19	39.51
606/0	2.610	1759.22	1017	42.68	39.98	40.23	41.48	41.02	40.27

TABLE C-4. NOZZLE CALIBRATION DATA  
FOR SRB-ALONE CLASS

Run/ Rerun	$P_{amb}$ (psia)	$P_c$ (psia)	$T_c$ (°R)	$P_c/P_w$		
				Tap No.		
				3	2	1
Test 10, $G_1$ , $N_{11}$ (Air, $A/A_* = 8.0$ , 15 deg)						
116/0	14.486	1186.1	923	29.2	59.1	82.1
117/0	14.486	394.2	811	30.6	60.5	85.1
Test 10, $G_1$ , $N_{12}$ (Air, $A/A_* = 5.0$ , 25 deg)						
35/0	14.479	1275.8		27.8	35.2	45.9
36/0	14.475	827.4		27.5	35.0	45.8
37/0	14.473	412.3		27.5	35.3	46.5
Test 10, $G_2$ , $N_{11}$ ( $CF_4$ , $A/A_* = 8.0$ , 15 deg)						
112/0	14.448	1235.1	991	18.1	32.7	42.8
113/0	14.509	417.5	852	19.5	34.3	45.7
114/1	14.507	1547.3	973	19.7	33.6	44.3

## APPENDIX D

### BIBLIOGRAPHY OF TEST DATA REPORTS

#### Test 1

Andrews, C. Donald and Cooper, C. E., Jr.: A Transonic and Supersonic Investigation of Jet Exhaust Plume Effects on the Afterbody and Base Pressures of a Body of Revolution. LMSC-HREC D306909, Lockheed Missiles and Space Company, 1974.

#### Test 2

Hair, Leroy M.: Test Data Report for Solid Propellant Plume Aerodynamics Test Program in MSFC 14 x 14 Inch Trisonic Wind Tunnel. RTR 016-1, REMTECH, Inc., 1974.

#### Test 3

Andrews, C. Donald and Ketter, F. C., Jr.: A Subsonic and Transonic Investigation of Triple Nozzle Jet Exhaust Plume Effects on the Base Pressures of a Body of Revolution. LMSC-HREC D390200, Lockheed Missiles and Space Company, 1974.

#### Test 4A, 4B

Andrews, C. Donald: A Subsonic and Transonic Investigation of Jet Exhaust Plume Effects on the Afterbody and Base Pressures of a Body of Revolution in the NASA-ARC 6 x 6 Foot Supersonic Wind Tunnel. LMSC-HREC D390656, Lockheed Missiles and Space Company, 1975.

#### Test 4C

Andrews, C. Donald: An Investigation of Solid Rocket Booster Jet Exhaust Plume Effects on the Base Pressures of the Space Shuttle External Tank and Solid Rocket Booster, Interim Report. LMSC-HREC D390657, Lockheed Missiles and Space Company, 1975.

#### Test 5

Hair, Leroy M.: Test Data From Solid Propellant Plume Aerodynamics Test Program in Ames 6 x 6 Foot Supersonic Wind Tunnel. RTR 016-2, REMTECH, Inc., 1975.

#### Test 6

Baker, D. C.: Investigation of Solid Propellant Plume Effects on Model Base Pressures at Mach Numbers 0.5, 0.9, and 1.2. AEDC-DR-75-79, Arnold Engineering Development Center, 1975.

#### Test 7 (except $P_c$ )

Anderson, C. F.: An Experimental Investigation Into the Effects of Jet Plumes on the Space Shuttle External Tank Base Pressure Distributions. AEDC-DR-75-111, Arnold Engineering Development Center, 1975.

#### $P_c$ Values for Test 7

Boyle, W. W. and Jordan, T. A.: Tabulated Test Data and Plume Characteristics for the Plume Technology Test Program. M-9230-76-31, Northrop Services, Inc., 1976.

#### Test 8

Hendershot, K. C.: Results of the NASA/MSFC FA-23 Plume Technology Test Program Performed in the NASA/Ames Unitary Wind Tunnels. XN-5798-A-2, Calspan Corp., 1977.

Nickel, Charles E.: FA23 Data Selection. RM016-7, REMTECH, Inc., 1977.

#### Test 9

Love, Don A.: A Subsonic, Transonic and Supersonic Investigation of Triple and Single Nozzle Jet Exhaust Plume Effects on the Base Pressures of a Body of Revolution (FA15). LMSC-HREC D568090, Lockheed Missiles and Space Company, 1977.

#### Test 10

Love, Don A.: Investigation of Jet Exhaust and Local Mach Number Effects on the Solid Rocket Booster (SRB) Base Pressures (FA19) Final Report. LMSC-HREC D568157, Lockheed Missiles and Space Company, 1978.

## APPROVAL

### SPACE SHUTTLE AFTERBODY AERODYNAMICS/ PLUME SIMULATION DATA SUMMARY

By Kenneth L. Blackwell and Leroy M. Hair

The information in this report has been reviewed for technical content. Review of any information concerning Department of Defense or nuclear energy activities or programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.



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Director, Systems Dynamics Laboratory



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16. ABSTRACT  A series of parametric wind tunnel tests was conducted to provide a base for developing a simulation of afterbody/base aerodynamics for multibody/multibase rocket-powered vehicles (such as Space Shuttle) which use unheated air as the simulant gas in development wind tunnel tests. The tests described herein were parameterized on external configuration, nozzle internal configuration, base geometry, propulsion gas type (air, CF <sub>4</sub> , solid propellant exhausts), and freestream Mach number (0.5 to 3.5). The tests were conducted over a 4-year period in the MSFC 14-Inch Trisonic, AEDC-PWT-4T, and Ames 11-Foot wind tunnels. Presented in this report are the data and pertinent reference information necessary to perform an analysis which would lead to a simulation procedure. The type of data obtained during the tests described herein include model base, afterbody, and nozzle internal surface static pressure distributions, model chamber pressure and temperature, and freestream conditions. Also included is a brief description of simulation procedures that have been used by the Space Shuttle program.			
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